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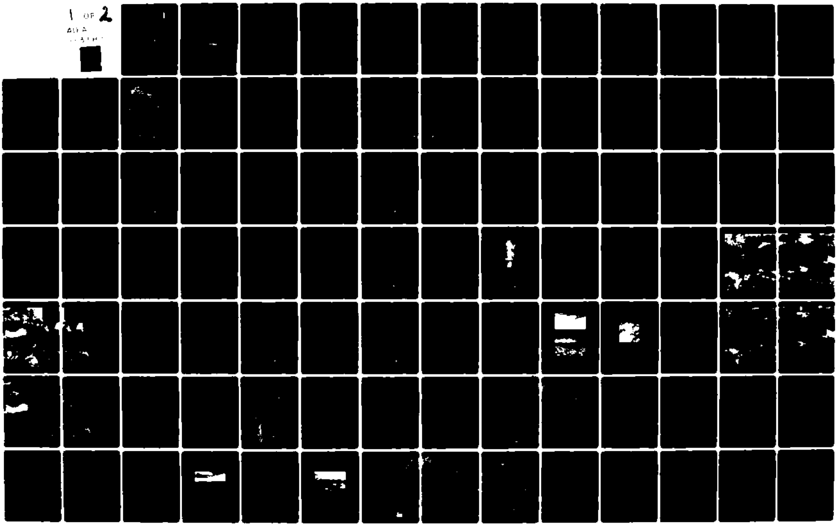

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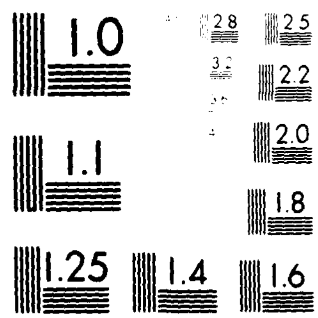

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FIELD SURVEYS, IOC VALLEYS
PROGRAM OVERVIEW AND METHODOLOGY

VOLUME I

Prepared for:

U. S. Department of the Air Force
Ballistic Missile Office
Norton Air Force Base, California 92409

Prepared by:

Ertec Western
3777 Long Beach Boulevard
Long Beach, California 90807

8 July 1981
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Results of the IOC field surveys program in Dry Lake Valley, Nevada gave a summary of methodology and problems associated with siting criteria and layout procedures.

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FOREWORD

This report was prepared for the Department of the Air Force, Ballistic Missile Office (BMO), in compliance with Contract No. F04704-80-C-0006, Task 4.5. The report, in three volumes, describes and evaluates procedures for shelter layouts and field studies consisting of land and environmental surveys and geotechnical inspections of sites and some road corridors in the IOC valleys.

This volume, Volume I, presents an overview of the program, evaluates the procedures and summarizes the findings in Dry Lake Valley, Nevada, and Pine and Wah Wah valleys, Utah. Volume II describes the biological resources of the area and is divided into Part I - Dry Lake Valley and Part II - Pine and Wah Wah valleys. Volume III describes the cultural resources and is similarly divided.

Changes to the baseline criteria and requirements made during the field surveys include:

- o Deletion of the Remote Surveillance Sites (RSS) as of 12 March 1981;
- o Major rerouting of the Designated Transportation Network (DTN) in northern Wah Wah Valley; and
- o Modification of the road pattern from straight-line to direct-connect.

No shelter relocations or reorientations were made as a result of the baseline change from straight-line cluster roads to direct-connect roads. Recent layout studies indicate that shelter sites investigated for the study can be used for the direct-connect concept; however, the orientation of some shelters could be improved if new direct-connect layouts were performed. It is expected that most or all of the Cluster Maintenance Facility (CMF) sites will have to be relocated for the direct-connect concept.

Additional studies are planned as part of the IOC program. These include:

- o Consultations with Utah and Nevada State Historic Preservation Offices (SHPO) to evaluate significance of sites in the IOC valleys and their potential for inclusion in the National Register of Historic Sites;
- o Determination of project effects on significant cultural resources;

- Development of possible cultural resource mitigation measures; and

- Native American consultations.

The results of these additional tasks will be incorporated in revisions of Volume III of this report and in a supplemental report which will be completed during FY 82.

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EXECUTIVE SUMMARY

The IOC field surveys program was designed to identify problems associated with siting criteria and layout procedures; assess environmental and geotechnical conditions at Horizontal Shelter Sites (HSSs), Cluster Maintenance Facilities (CMFs), Remote Surveillence Sites (RSSs), and along some road corridors: determine changes necessary at a site to improve location and reduce impact: develop a methodology for future field surveys; and provide legal descriptions of each site that will be withdrawn from public use. The term IOC refers to Air Force plans for an Initial Operational Capability of 10 missiles by mid-1986. Dry Lake Valley, Nevada, was chosen due to its proximity to a proposed Operational Base (OB) at Coyote Spring Valley and because the suitable area within the valley could support 10 clusters. Pine and Wah Wah valleys, Utah, were chosen for their proximity to a proposed OB in either the Milford or Beryl area and because together they could support 10 clusters.

Surveying sites in the IOC Valleys began in August 1980 and was completed in March 1981. The following facilities and roads were surveyed:

	NEVADA	UTAH	
	Dry Lake Valley	Pine Valley	Wah Wah Valley
Number of Clusters	10	5	5
Number of Shelters	230	115	115
Number of CMFs	10	5	5
Number of RSSs	5	4	4
DTN	39 miles (62 km)	0	0
Cluster 2 Roads	30 miles (48 km)	0	0

Mitigation criteria for archeological and biological resources and adverse geotechnical conditions were developed and applied where warranted to improve site locations and reduce environmental impact. In most cases, if significant environmental resources were found, or adverse geotechnical conditions were present, the site was relocated (mitigation by avoidance) to proximal locations or to other suitable locations within the cluster area. Waivers of the following siting criteria were made on a case-by-case basis, based on the results of the field surveys:

- o Siting outside of suitable area;
- o Siting a shelter with four nearest neighbors; and
- o Violation of spacing of backfills.

A total of 71 sites were relocated as summarized in the table below:

	NEVADA		UTAH					
	Dry Lake Valley		Pine Valley		Wah Wah Valley		Total IOC Valleys	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Archeological	3	13	1	4.5	2	8	6	8
Biological	0	0	1	4.5	0	0	1	1
Geotechnical:								
Fault	2	9	1	4.5	0	0	3	4
Bedrock	1	4	0	0	1	4	2	3
Earth cracks	2	9	0	0	0	0	2	3
Wash in front of shelter	3	13	4	18	4	15	11	15
Wash affecting shelter	6	26	4	18	7	27	17	24
Wash at rear of shelter	1	4	6	27	2	8	9	13
Playa	0	0	1	4.5	0	0	1	1
Cultural	0	0	3	14	0	0	3	4
Criteria	5	22	1	4.5	10	38	16	23
Totals	23		22		26		71	

Approximately 5.5 miles (9 km) of the Designated Transportation Network (DTN) in Dry Lake Valley was relocated to avoid a series of archeological sites located along the playa margin.

This volume (Volume I) presents a summary of the methodology and results of the IOC field surveys. Volumes II and III present methodology and results of biological and cultural resources, respectively. Dry Lake Valley data are in Part I, and data for Pine and Wah Wah valleys are in Part II of each volume.

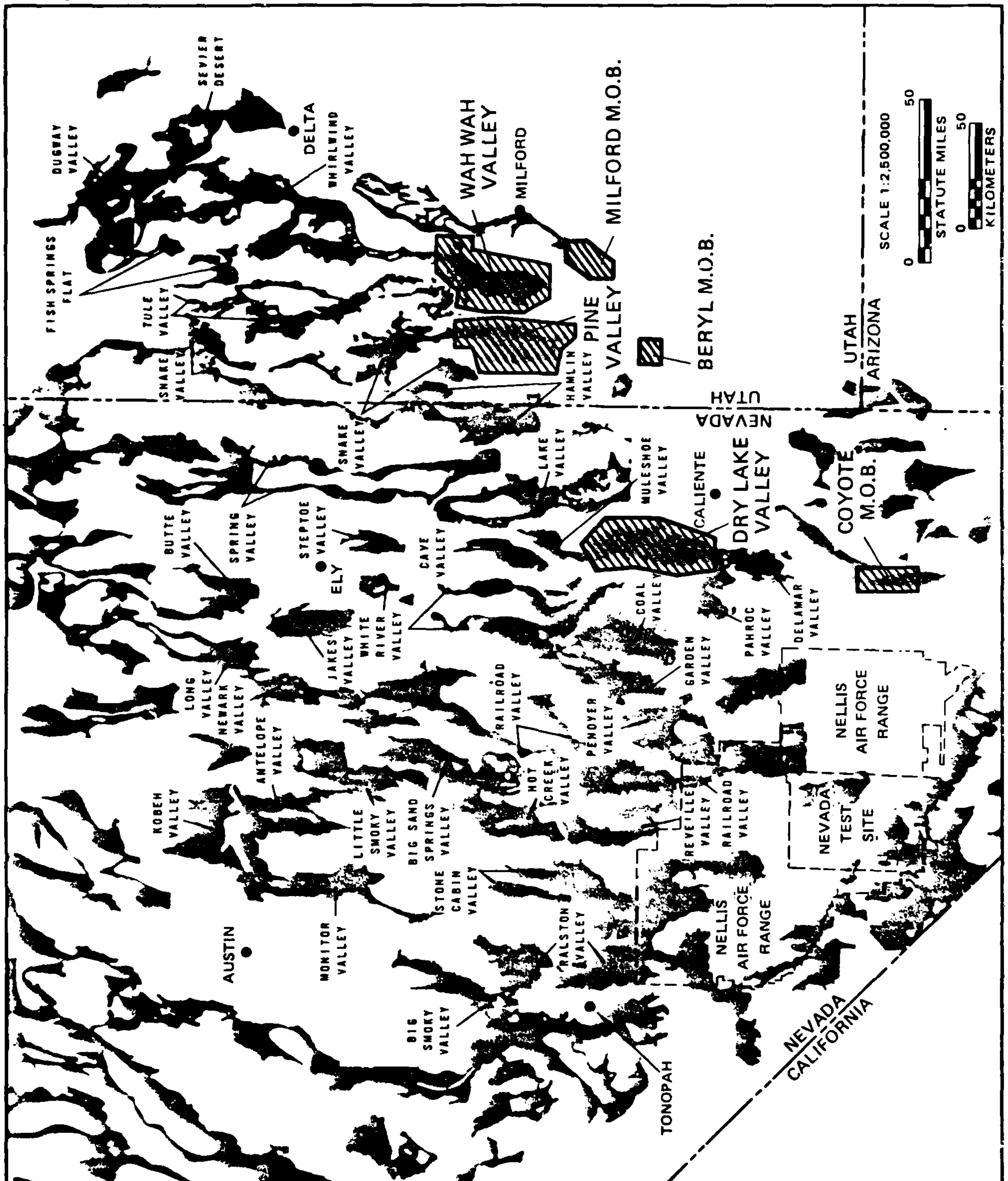
1.0 INTRODUCTION

1.1 BACKGROUND

In April and May of 1980, the AFRCE proposed to initiate field studies in selected Nevada and Utah valleys for the purposes of testing cluster layout procedures and determining potential field problems in actual shelter siting. Dry Lake, Nevada, was selected because it was large enough to support 10 clusters and was relatively close to the proposed Operational Base (OB) site in Coyote Spring Valley. Pine and Wah Wah valleys, Utah, were selected because they were the closest valleys to proposed OB sites near the towns of Beryl and Milford and, together, could support 10 clusters (Figure 1-1).

According to present Air Force plans, there is to be an Initial Operational Capability (IOC) of 10 clusters by mid-1986. There is a high likelihood that shelter construction would start either in Dry Lake Valley, Nevada, or Pine and Wah Wah valleys, Utah, to meet the IOC schedule. For this reason, the present program is referred to as field surveys, IOC valleys.

The intent of the IOC field surveys program was to support the development of the siting methodology and the land withdrawal application being submitted to Congress by the U.S. Air Force. The land withdrawal package must include a legal description of federal lands to be withdrawn for MX. The field program for the IOC valleys was developed after consultations with AFRCE-MX and Utah and Nevada state offices of the Bureau of Land Management (BLM).



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BMO/AFRCE-MX

IOC VALLEYS

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FIGURE 1-1

1.2 OBJECTIVES

The primary objectives of the IOC field surveys were to:

- o Identify problems associated with siting criteria or layout procedures by actually locating Horizontal Shelter Sites (HSSs), Cluster Maintenance Facilities (CMFs) and Remote Surveillance Sites (RSSs) in the field;
- o Assess environmental and geotechnical conditions at the shelter, CMFs, and RSSs and along a few road corridors and determine what changes are needed to minimize impacts;
- o Develop a methodology for performing field surveys in the Designated Deployment Area (DDA); and
- o Provide legal descriptions of surveyed sites for the land withdrawal application.

The elements of the program are as follows:

- o Complete shelter layouts for Dry Lake, Pine, and Wah Wah valleys at a scale of 1:62,500 showing all shelter, CMFs, and RSSs.
- o Submit layouts to BMO/AFRCE for review. Modify the layouts, if needed, in accordance with review comments.
- o Transfer the layout to 1:9600 scale topographic maps. Adjust site locations, if necessary, to avoid drainages and other features that can be identified on the drawings at this scale.
- o Determine the state plane coordinates and bearings of all structures. In Dry Lake Valley, determine the coordinates of points of intersection of the Designated Transportation Network (DTN) and Cluster 2 roads. Provide the land surveyors with these data.
- o Perform field surveys to locate and monument each site and stake the centerline of the DTN and Cluster 2 roads in Dry Lake Valley.
- o Perform geotechnical inspections of sites to determine if they are located in suitable area and to evaluate site-specific geotechnical and terrain conditions. Based on evaluations, recommend which sites should be relocated.
- o Inventory cultural resources including prehistoric and historical artifacts and sites and determine which resources may be adversely affected by project construction. Based on consultation with Bureau of Land Management archeologists,

make recommendations to mitigate adverse effects on resources eligible for the National Register of Historic Places or considered significant for other reasons.

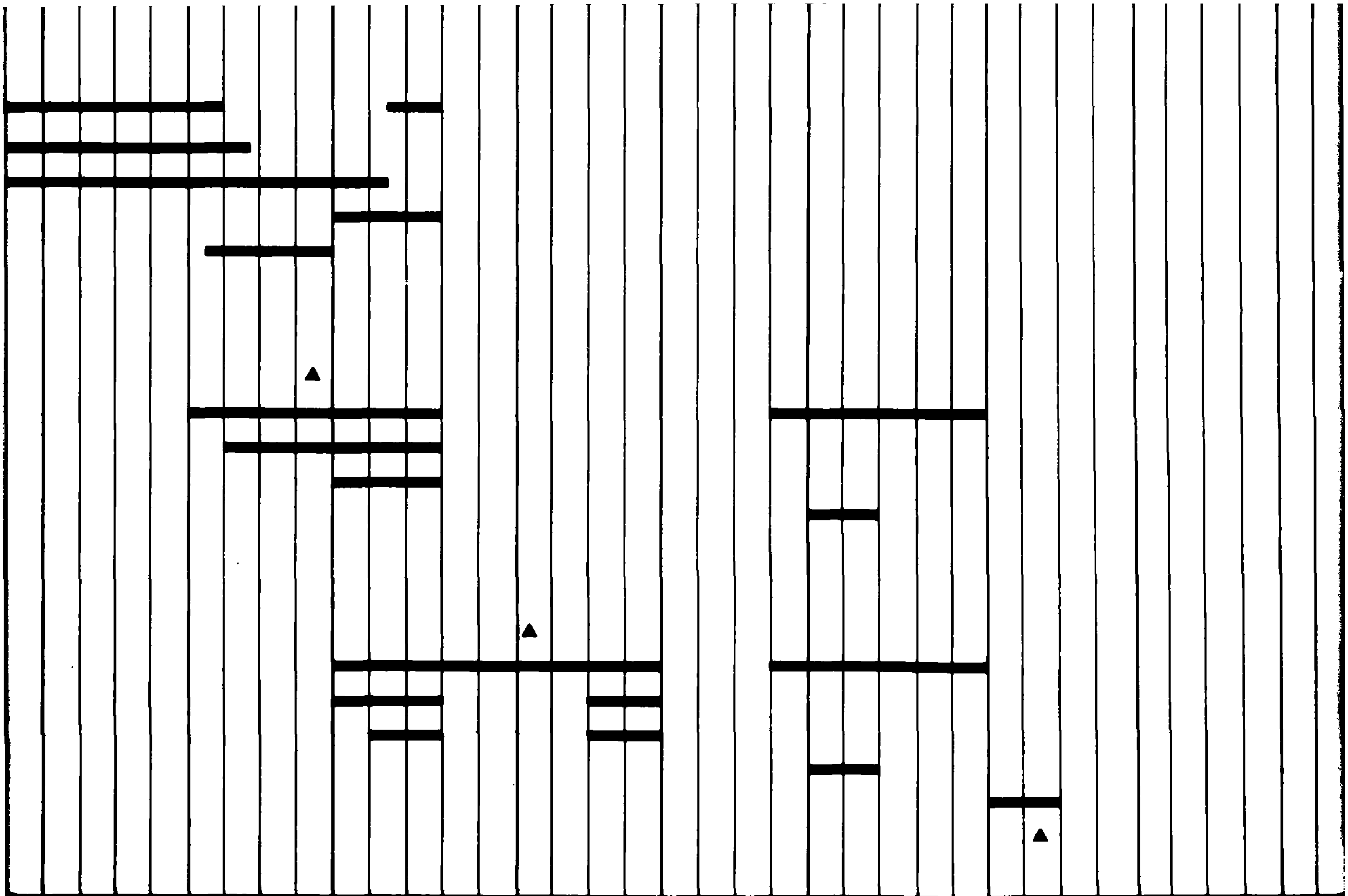
- o Perform biological inspections to determine the location of sensitive, threatened, and endangered plant and wildlife species that may be adversely affected by project construction. Recommend mitigative measures, when possible, based upon consultation with personnel from state and federal agencies.
- o Submit recommendations to BMO/AFRCE for field and office review. After final decisions have been made regarding the number of sites to be relocated, layouts are revised, new coordinates are generated, sites are resurveyed and monumented, and environmental surveys are completed.
- o Prepare legal descriptions of the land at each site that will be withdrawn from public use; and
- o Prepare an environmental report and general report of the program.

The layouts for Dry Lake, Pine, and Wah Wah valleys, at a scale of 1:9600, were completed 8 September 1980, 25 November 1980, and 8 January 1981, respectively. Locating existing survey controls and establishing a control grid over Dry Lake Valley began on 28 August 1980; surveying and monumenting shelter sites began shortly thereafter. The cultural resources and biological field surveys and geotechnical inspections began 29 September 1980 in Dry Lake Valley and were completed for all valleys on 15 March 1981. An effort was made to complete as much field work as possible by December 1980 knowing there would be delays in the winter months because of weather conditions. A completed schedule is shown in Figure 1-2.

1.3 REPORT ORGANIZATION

This report presents a description of the data and techniques used to derive shelter layouts. Valley-specific information

TASK DESCRIPTION	AUG			SEPT				OCT				N	
	11	18	25	8	15	22	29	6	13	20	27	3	10
DRY LAKE VALLEY													
LAYOUT COMPLETED (1:9600 SCALE)													
SURVEYING AND MONUMENTING													
ENVIRONMENTAL INSPECTIONS													
GEOTECHNICAL INSPECTIONS													
ENVIRONMENTAL FIELD SURVEYS–RESITINGS													
DETAIL OF CLUSTER 2 (SURVEYING)													
PINE VALLEY													
LAYOUT COMPLETED (1:9600 SCALE)													
SURVEYING AND MONUMENTING													
ENVIRONMENTAL FIELD SURVEYS													
GEOTECHNICAL INSPECTIONS													
ENVIRONMENTAL FIELD SURVEYS–RESITINGS													
WAH WAH VALLEY													
LAYOUT COMPLETED (1:9600 SCALE)													
SURVEYING AND MONUMENTING													
ENVIRONMENTAL FIELD SURVEYS													
GEOTECHNICAL INSPECTIONS													
ENVIRONMENTAL FIELD SURVEYS–RESITINGS													
COMPLETE RESITINGS (CHANGES TO LAYOUT AFTER FIELD SURVEYS)													
DRAFT REPORT TO U.S. AIR FORCE													
FINAL REPORT													



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SCHEDULE OF FIELD SURVEYS

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FIGURE 1-2

and results of the field surveys for the three IOC valleys are summarized. An evaluation of the methods and techniques forms the basis for recommended program and method changes.

The report consists of three volumes. Volumes II and III contain two parts which are bound separately. The contents of each volume are as follows:

Volume I	- Program Overview and Methodology;
Volume II, Part I	- Biological Resources, Dry Lake Valley, Nevada;
Volume II, Part II	- Biological Resources, Pine and Wah Wah valleys, Utah;
Volume III, Part I	- Cultural Resources, Dry Lake Valley, Nevada; and
Volume III, Part II	- Cultural Resources, Pine and Wah Wah valleys, Utah.

2.0 METHODOLOGY

2.1 PREVIOUS STUDIES

Suitable areas for deployment of the MX missile system were defined in preceding geotechnical programs known as Screening, Characterization, Geotechnical Ranking, and Verification.

Screening consisted of nationwide literature and map studies to identify potentially suitable areas based on geotechnical, cultural, and environmental criteria. Three phases, Coarse, Intermediate, and Fine, were used to identify approximately 74,000 mi^2 (192,000 km^2) in seven western states as potentially suitable. Coarse and Intermediate Screening identified suitable area by applying exclusion criteria. Fine Screening defined cultural and geotechnical conditions within areas already found to be technically suitable.

Characterization consisted of field studies in representative areas to better define geotechnical conditions and refine boundaries of suitable area that were identified during Screening. The studies were designed to use rapid, relatively inexpensive methods of gathering data on terrain conditions, properties of surficial soils, and depth to rock and water.

Based on the Screening and Characterization studies, potential suitable areas were divided into seven Candidate Siting Regions. These same studies provided the data used to rank the seven regions based on the relative cost of geotechnically related construction items. The rankings were performed for the hybrid

trench, vertical shelter, and horizontal shelter MX basing modes.

The next phase in the siting methodology is known as Verification. These studies were initiated in Nevada and Utah to refine boundaries of suitable area; obtain geologic, geophysical, and engineering data for preliminary design studies; identify problem areas where additional field work is required; and recommend additional sites for study in Nevada-Utah to ensure that there is sufficient suitable area for deployment of the MX system. Verification is an important program for the field surveys and is discussed in more detail in the following section.

2.1.1 Scope of Verification Studies

Verification studies consist of a combination of geologic, geophysical, and soils engineering techniques designed to differentiate suitable and nonsuitable area and obtain basic information on soil and terrain characterisitics. Verification studies began with geologic mapping of stereo pairs of aerial photographs. Geologic units are defined based on age, geomorphology, grain size of surficial soils, drainage characteristics, and other signatures of the area that are identified on the photos, such as shallow depth to rock and/or water. A field program is planned that includes basic engineering test procedures (test pits and trenches, borings, sampling, water-level observation wells, cone penetrometer tests, seismic refraction, and electrical resistivity) and site-specific determination of the physical properties of mapped geologic units. The geologic and engineering studies are used to prepare a map which show areas within

the valleys that will not be suitable for missile deployment including:

- o Slopes greater than 10 percent grade;
- o Areas with high incidence of 10 percent slopes (rolling terrain);
- o Surface expression of rock;
- o Subsurface rock less than 50 feet (15 m) deep;
- o Surface expression of water; and
- o Subsurface water less than 50 feet (15 m) deep.

In addition, the extent, in terms of physical properties, of similar units of basin-fill material are defined.

Verification studies were performed in Dry Lake Valley during the summer of 1977 and the fall of 1979. The initial work was summarized in report FN-TR-26c and additional Verification studies was summarized in FN-TR-27-DL. Pine and Wah Wah valleys were verified during spring and summer of 1980 (FY 79) and are summarized in FN-TR-27-PI and FN-TR-27-WA, respectively.

2.1.2 "Siteable" Areas for Shelters

The maps that result from Verification studies show suitable area boundaries in accordance with the criteria listed in the previous section. However, these maps provide no information as to preferred siting areas within the valleys. As part of the layout process, geotechnically "siteable" area maps are prepared. These maps are derived from the surficial geologic, fault, and terrain maps prepared as part of the Verification study. The siteable area maps identify geotechnical factors which can impact siting of shelters, CMFs, and roads; the

factors include playas, major drainages, areas subject to sheet flooding, and active or potentially active faults. The maps group basin-fill units and terrain conditions that will behave in a similar manner during construction and excavation or in response to natural processes such as erosion or flooding. A standoff zone is established around known faults that delineates areas to avoid during siting. The width of the zone is dependent on the characteristic of the fault(s) and the certainty with which it is located.

A classification and ranking system was devised and applied to the basin-fill areas as follows:

- Unsuitable for shelters or roads (areas of rock greater than 10 percent slope, adverse terrain, standing water);
- Unsuitable for shelters, try to avoid for roads (shallow rock or water, active or potentially active fault zones, active playa); and
- Try to avoid for shelters or roads (potential sheet wash, greater than five percent slope).

The siteable area maps provided an effective means by which the geotechnical data could easily be interpreted and utilized during the layout process.

2.2 LAYOUTS

Ertec Western, Inc. (formerly Fugro National, Inc.) began multiple-protective structure (shelter) layouts in FY 79. Dry Lake Valley, Nevada, was chosen as the study area and was used to develop a methodology and procedures. At the time the studies were initiated, the loop road basing concept and a variety of shelter spacings, ranging from 5000 to 7000 feet (1524 to

2134 m), were considered. Initial layouts were completed at a scale of 1:62,500 (1 inch = 1 mile [1 cm = 625 m]). Experimentation with transferring the layouts to larger map scales at 1:9600 (1 inch = 800 feet [1 cm = 96 m]) and 1:4800 (1 inch = 400 feet [1 cm = 48 m]) showed that the 1:9600 scale maps provided enough detail to adjust layouts for terrain and geotechnical conditions not possible at the smaller map scale. A BMO/AFRCE-MX document, "MX Site Layout Requirement for a Horizontal Shelter with Separate Transporter and Erector Launcher System - Nevada/Utah" (6 June 1980), provided the siting requirements for all subsequent layouts.

2.2.1 Layout Requirements

The above cited document and supplementary addenda in the form of verbal and written directives from BMO/AFRCE-MX has resulted in the current siting requirements. These requirements formed the basis for the shelter layouts in Dry Lake, Pine, and Wah Wah valleys. The key elements of layout criteria are:

- o Open hexagonal pattern, 2/3 filled;
- o Shelter spacing of 5200 feet $\pm$ 200 feet (1585 m $\pm$ 61 m);
- o Maximum of three nearest neighbors per primary shelter (Multiple Protective Shelter [MPS]);
- o Shelter orientation away from nearest neighbor by 60 degrees (minimum 55 degrees);
- o Cluster road grades not to exceed five percent;
- o Cluster trunk roads to be oriented north-south as much as possible;
- o Each cluster to contain 34 or 35 shelter positions: 23 primary and 11 or 12 secondary ("backfill") positions;
- o Apply appropriate Quantity Distances (QD) as per AFR-127-100 to existing highways, inhabited buildings, power lines and

power generating facilities, pipelines, and microwave facilities;

- o Avoid, when possible, private land, proposed utility corridors, and environmentally sensitive areas;
- o Exclude areas specified by federal law, Air Force policy, Corps of Engineers (COE), Real Estate Planning Report (REPR) recommendations: e.g., patented mining claims, oil fields.

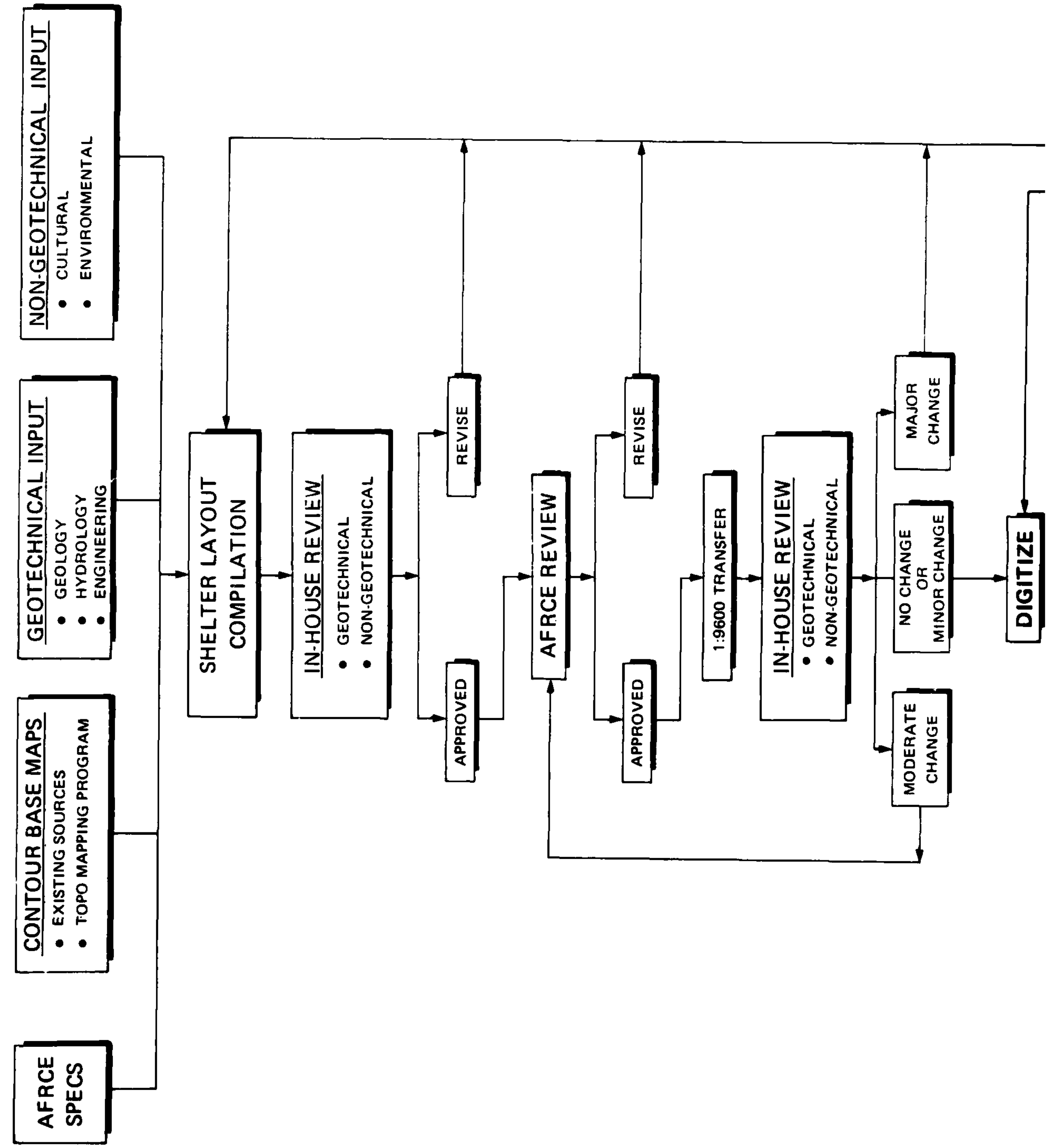
As work progressed on the layouts, additional siting requirements were developed and applied on an "avoid-if-possible" basis. These included:

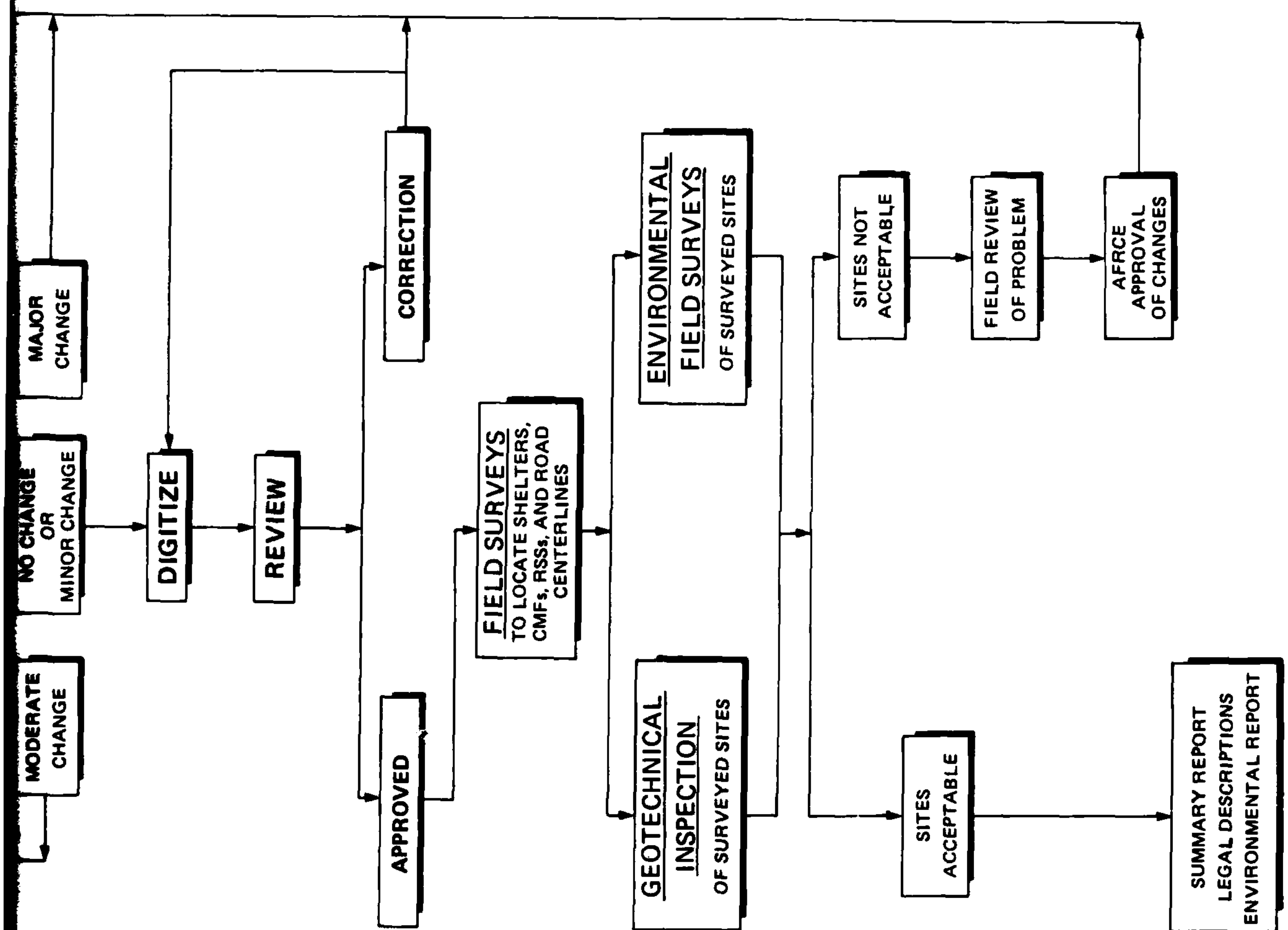
- o Large drainages; and
- o Active or potentially active faults or fault zones.

2.2.2 Layout Methodology

Shelter layouts were developed following geotechnical Verification studies which were predicated on geologic, engineering, and hydrologic field programs. Real estate land use data were received from the COE and BLM. Environmental data for five valleys were received from Henningson, Durham and Richardson (HDR).

The layout process involved synthesizing the basic inputs and clustering within the valleys (Figure 2-1). A series of map overlays were produced at 1:62,500 map scale for the geotechnical and nongeotechnical data. Overlays were prepared that contained cultural data such as Wilderness Areas or Wilderness Study Areas boundaries, power corridors, registered Historic Sites, mining areas, parks, and wildlife management areas. Zones are delineated that show required stand-off distances from occupied buildings, power lines, roads, etc. Data are collected on the ownership of the land contained within the valleys.


AFRCE SPECS
CONTOUR BASE MAPS
• EXISTING SOURCES
• TOPO MAPPING PROGRAM
GEOTECHNICAL INPUT
• GEOLOGY
• HYDROLOGY
• ENGINEERING
NON-GEOTECHNICAL INPUT
• CULTURAL
• ENVIRONMENTAL
SHELTER LAYOUT COMPILATION
IN-HOUSE REVIEW
• GEOTECHNICAL
• NON-GEOTECHNICAL
APPROVED
REVISE
AFRCE REVIEW
APPROVED
REVISE
1:9600 TRANSFER
IN-HOUSE REVIEW
• GEOTECHNICAL
• NON-GEOTECHNICAL
MODERATE CHANGE
NO CHANGE OR MINOR CHANGE
MAJOR CHANGE
DIGITIZE



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SHELTER LAYOUT PROGRAM
FOR FIELD SURVEYS
OF IOC VALLEYS

8 JUL 81

FIGURE 2-1

These overlays, in conjunction with the geotechnically siteable area maps, provide qualitative data on the valleys. These overlays were registered to a 1:62,500-topographic contour base which was a photo composite of existing U.S. Geological Survey (USGS) 7 1/2', 15', and 2° map sheets.

The actual layout process for HSS locations was based on a hexagonal grid cell using 5200 feet (1585 m) spacing at 1:62,500 scale. The compilation of the layout began with an adjustment of the grid to obtain the highest counts of grid points possible. Considerations were given to the siting requirements as they constrained clustering (the process of grouping a series of 34 or 35 adjacent points).

Following the layout compilation, an in-house review process involved checking the basic layout geometry. The land status conditions were reviewed for compliance. Reviews by the Verification geology group and the fault study group were made. Once compliance was assured, reproductions were submitted to the Air Force for review and approval.

After the 1:62,500 layout was approved by BMO/AFRCE, the shelter locations were manually transferred to 1:9600 scale topographic maps. The larger scale, detailed maps more accurately reflected the topography, showed additional cultural features, and allowed refined measurements of the QDs. As a result, shelter positions were shifted slightly to avoid drainages, reserviors, drainage ditches, corrals and other siting considerations while maintaining siting criteria. If a major adjustment of shelter

location or orientation was required to avoid a wash or cultural feature, it was necessary to adjust all other shelter points to maintain the hexagonal grid spacing. Several such shifts produced a cascade effect throughout the valley. The accumulative shift was most significant in the north to south direction (i.e., long axis) of the valley.

A review of the 1:9600 transfer was performed following the same process as the 1:62,500 layout. Upon completion, the 1:9600 transfer was digitized, and internal checks were run by computer to verify compliance with distances and angles between shelters. State plane coordinates for the digitized point at each site were generated. The survey coordinates and bearings were tabulated by cluster and given to Ertec Airborne Systems, Inc. for distribution to the land surveyors.

2.3 SURVEYS AND MITIGATION CRITERIA

The field surveys consisted of locating and monumenting each shelter, CMF, and RSS in all three valleys and the centerline of the DTN and Cluster 2 roads in Dry Lake Valley. Environmental surveys of all the above sites and roads and geotechnical inspections of the shelters and CMFs comprised the other aspects of the IOC field surveys.

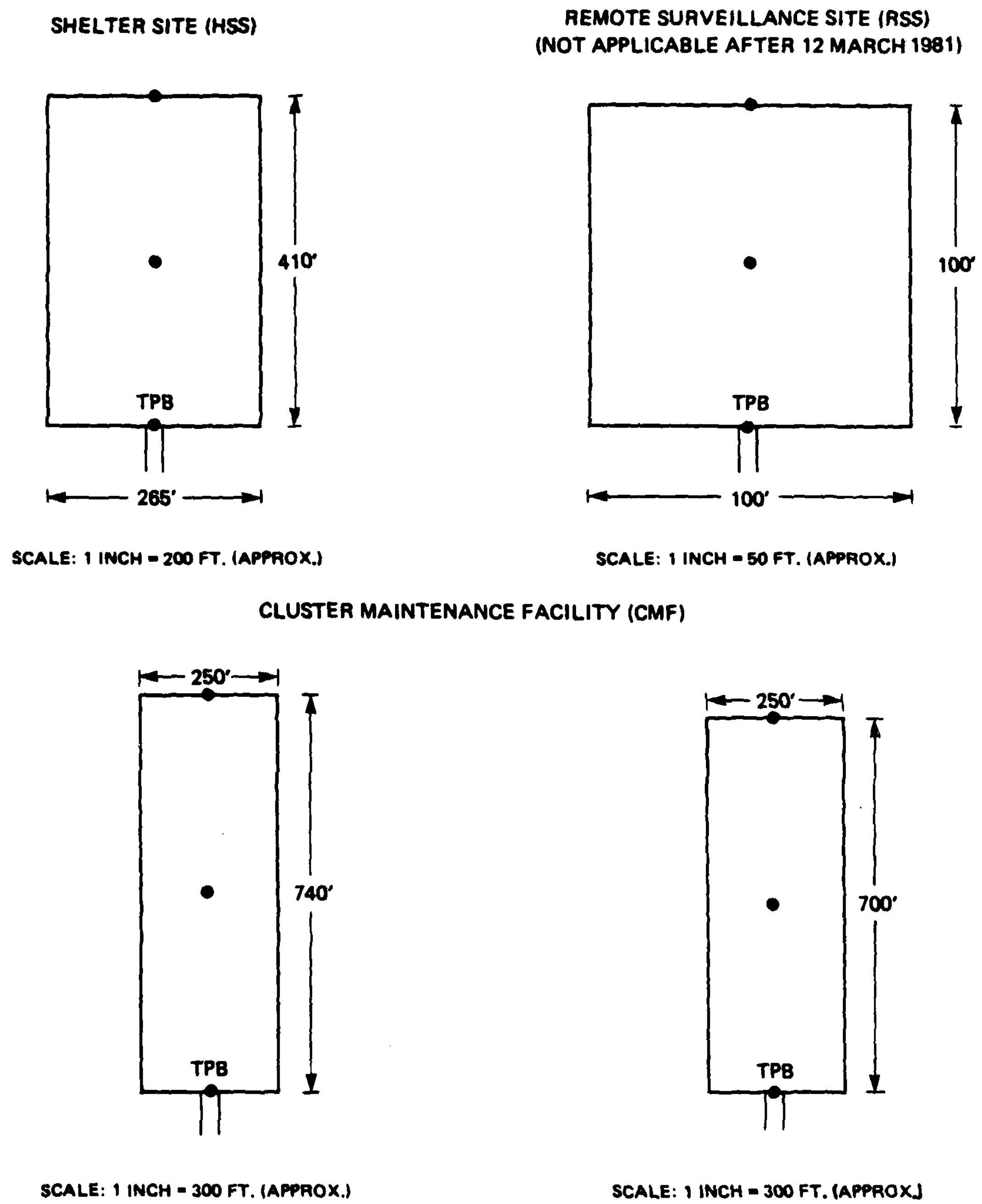
2.3.1 SURVEYING AND MONUMENTING SHELTERS

Although not specifically a part of the IOC field surveys, certain preliminary field studies were required to produce the 1:9600 scale topographic maps of the IOC valleys. These included an inventory and recovery of existing control points on

record with the U.S. Coast and Geodetic Survey (USCGS) and other agencies. Additional control points were surveyed and marked in the field. These control points were used as reference markers for exact location and elevation and used both for the topographic maps and the IOC field surveys. Control points were established at approximately 6-mile (10-km) intervals north to south, generally corresponding to township lines, and at approximately 2-1/2- to 3-mile (4- to 5-km) intervals east to west. This preliminary recovery and marking of control points was done by Ertec Airborne Systems, Inc.

Site surveying and monumenting were performed by Johnson-Frank and Associates, Ely, Nevada (Dry Lake Valley, Nevada), and Valley Engineering, Inc., Logan and Ogden, Utah (Pine and Wah Wah valleys, Utah).

The land surveyors were supplied with the coordinates (referenced to the proper state plane coordinate system) for a point midway on the fence line of the shelter, CMF, or RSS, referred to as the True Point of Beginning (TPB). A bearing, looking into the facility, provided a centerline along which two other points were set. The various sites were laid out using a traverse technique commencing at one known control point, and closing at a different known control point. All surveyed points were required to meet third-order criteria (1 foot in 5000 feet) for field methods and resultant position closure. A 3-inch (8-cm) diameter aluminum cap fixed to rebar (referred to as a monument) was driven into the ground at three points along the site centerline (Figure 2-2). The caps were marked with cluster



THE DIMENSIONS OF THE SITES REPRESENT THE AMOUNT OF LAND THAT WILL BE WITHDRAWN FROM PUBLIC USE.

EXPLANATION

● MONUMENT

TPB TRUE POINT OF BEGINNING

| | ROAD

THE HSS SCHEMATIC SHOWN HERE IS BASED ON THE BASELINE CONCEPT IN EFFECT AT THE TIME OF THE IOC FIELD SURVEYS.

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DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

SCHEMATIC OF SURVEYED SITES FOR THE IOC FIELD SURVEYS

8 JUL 81 — FIGURE 2-2

and shelter or CMF number, the registration number of the land surveyor, and a code to identify the point as either the TPB, center, or rear of the site.

The centerlines of approximately 39 miles (63 km) of the DTN and 30 miles (48 km) of Cluster 2 roads in Dry Lake Valley were also staked. The roads were defined by straight-line segments between given Points of Intersection (PI) which marked a change in direction of the road bearing. The road alignment was conceptual in nature and, therefore, detailed curved segments of the road were not defined for this study. The DTN was marked by wooden laths at approximately 1/4-mile (0.4-km) intervals. The cluster roads were staked at much closer intervals so that all changes in topography would be reflected. These laths formed stations for detailed plan and profile sections of the road alignment.

Detailed topographic surveys of each of the 23 shelter sites in Cluster 2 in Dry Lake Valley were made. Standard ground survey techniques using a grid point layout were employed. Plat maps at a scale of 1 inch = 40 feet (1 cm = 5 m) and a contour interval of 1 foot (0.3 m) were produced. Existing channels, washes, roads, and other features were added to the plat maps to provide greater detail. These topographic maps were the first made at this scale and detail within the Designated Deployment Area (DDA). They provided a means of determining detailed terrain conditions and will be used to evaluate whether or not greater detail, not resolvable during the photogrammetric

process, can be efficiently obtained. Data obtained from the detailed plat maps are presented in Appendix A3.0 which evaluates differences between topographic maps with 1-foot (0.3-m) and 10-foot (3-m) contour intervals.

2.3.2 ENVIRONMENTAL SURVEYS

This section will provide a brief, generalized summary of field techniques and mitigation analysis of the environmental field program. A more detailed description is presented in Volumes II and III of this report. Biological and cultural resources surveys were conducted at each shelter site, CMF, and RSS in all three IOC valleys and along the DTN and Cluster 2 road centerline in Dry Lake Valley. The environmental field program identified existing biological and cultural resources at specific sites, determined the overall environmental characteristics of the valleys, and defined potential conflicts between construction of the MX missile system and existing environmental resources. The research methodology and procedures were developed in coordination with the AFRCE, Utah and Nevada state BLM offices and various state agencies, research institutes, and universities. An attempt was made to standardize the survey and recording techniques so the data collected for the IOC field survey program would be compatible with other information compiled for the MX system and with existing data bases for the Great Basin region.

Survey teams consisted of two field archeologists, a botanist, and a wildlife specialist. Field crews located the sites using

both the 1:62,500 and 1:9600 base maps. The environmental survey area was established by the field crews from the monuments marking the centerline of the sites. A buffer zone, 200 feet (61 m) larger in all dimensions than the site dimensions, was surveyed. It was felt that this larger area would effectively cover all the ground that would be impacted, directly or indirectly, during construction. Corners of the environmental survey area were located using tapes and right angle prisms and marked by flags attached to wires.

After the corners of the environmental survey areas were located, the area was systematically examined for significant archeological, cultural, or biological finds by walking transects at 82-foot (25-m) intervals along the long axis of the unit. The biological crews also studied two 164-foot- (50-m-) line-intercept transects which measured the percent cover, percent relative cover, and density of flora within the site area. Several transects were measured if the site was covered by more than one vegetation association. Significant abiotic factors such as drainage, slope, elevation, amount of disturbance, and soil characteristics were noted and used in evaluating the overall environmental conditions.

The roads network was surveyed linearly with transects placed 41 feet (12.5 m) to either side of the staked centerline. Biological data were also collected at 5-mile (8-km) intervals utilizing transects perpendicular to the centerline.

No systematic collection system was established for archeological and cultural artifacts. Certain temporally diagnostic artifacts were collected in accordance with established BLM guidelines. All collected artifacts will be housed with the collections of the Museum of Natural History, University of Nevada, Las Vegas, and Southern Utah State College, Cedar City.

Voucher specimens for each vegetation association in the valley were collected. These collections document the biota found in the IOC valleys of the Great Basin. Collected specimens were also used for taxonomic studies when necessary. Voucher specimens were stored at Ertec Northwest, Inc. A small program consisting of trapping of small rodents completed the faunal analysis.

2.3.3 ENVIRONMENTAL MITIGATION CRITERIA

The site-specific and ecosystem data collected during the field surveys of the valleys were evaluated to assess the impact of shelter construction and to provide recommendations for shelter, CMF, and, in Dry Lake Valley, road relocations.

2.3.3.1 Archeological Criteria

A list of criteria used to evaluate significant sites which would be eligible for avoidance mitigation was developed with the Nevada BLM. The criteria reflect an agreement between BMO/AFRCE-MX and the BLM regarding protection of cultural resources from potential direct impacts for the IOC valleys. During the IOC field surveys, the AFRCE-MX followed a policy of avoidance

for significant sites. Other methods are available and could be employed for future site-specific mitigation.

Briefly, significant sites include:

- o Sites with high likelihood of depth or isolated features which demonstrate a possibility of depth:
- o Rock shelters exposed to project location;
- o Rock art sites;
- o Large lithic scatters containing temporally diagnostic artifacts;
- o Artifacts indicative of specific cultural affiliations, multicomponent sites, or sites composed of discrete multiple activity areas;
- o Burial sites;
- o Rock alignments and cairns;
- o Sites or structures greater than 50 years of age;
- o Shafts, adits, etc., associated with mining activities;
- o Cemeteries; and
- o Road or trail traces of early transportation routes.

2.3.3.2 Biological Criteria

Evaluating the potential impact of the MX missile system on the biological resources of the IOC valleys involved a consideration of direct and indirect impacts on the entire ecosystem rather than specific sites. For example, destruction of a food source, such as rabbits, may impact raptor populations that nest outside of the valley. The habits and size of migratory and nonmigratory wildlife and the presence of threatened, endangered, or sensitive flora and fauna will impact the project differently. Biological mitigation criteria, in general, were

approached on a case-by-case basis. Legal status, concerns of state regulatory agencies, and overall ecosystem impacts were prime factors in the decision criteria for site mitigation. Species interactions, migratory ranges, population distribution, value and reaction to man, and other factors required that the guidelines for biological mitigation remain flexible.

2.3.4 Geotechnical Inspections

Geotechnical inspections of shelter sites and CMFs were performed to determine site-specific geotechnical conditions, including the presence of playas, active or potentially active faults, washes, surface or shallow bedrock, caliche, and sheet flooding.

Several different methods were used to review and evaluate sites: color aerial photograph interpretation at 1:25,000 (1 inch = 2100 feet [1 cm = 250 m]), topographic map interpretation, on-site studies, and identification by the land surveyors and/or environmental teams. Highly conservative criteria were applied when identifying sites for potential geotechnical problems by remote methods, and all these sites were subjected to on-site inspections.

Geotechnical inspections consisted of review and evaluation of on-site conditions. At each site, the state, valley, cluster, and shelter were noted for identification purposes, and geologic unit; soil type; description of the surface including lithology of cobbles or gravel, degree of pavement and patina development, stage of caliche present, if any, and percent slope; description

of washes on or near the site, including depth, drainage area, and assessment of activity; and any other pertinent geologic features were described. If required, a sketch map of the site was drawn. Color photographs showing a general overview and any pertinent geotechnical features were taken at each site.

The geotechnical inspections were carried out by engineering geologists.

2.3.5 Geotechnical Mitigation Criteria

The on-site geotechnical inspections provided the first field test of the Verification program and were used to determine if the siting criteria had been inadvertently violated. A shelter or CMF was relocated if the following violations of siting criteria were observed:

- o Surface or shallow bedrock;
- o Adverse terrain;
- o Slopes steeper than 10 percent; and
- o Surface or shallow ground water.

If siting criteria had not been violated, a secondary group of factors was evaluated. Judgments were made on a case-by-case basis as to whether or not a shelter or CMF site should be relocated. In general, sites were relocated for any of the following reasons:

- o Proximity to active or potentially active fault zones;
- o Playa deposits;
- o Wash affecting ramp, road, or door of shelter;
- o Wash cutting across shelter;

- o Wash affecting proposed antenna location at rear of shelter;
- o Favorable location of natural drainages for flood protection;
- o Potential for sheet flooding; and
- o Ground cracks.

2.3.6 Field-Specific Cultural Features

In conjunction with the field work required for on-site geotechnical inspections, certain cultural features not evident from either the 1:62,500 or 1:9600 scale maps were noted. Mitigation in the form of site relocation occurred for:

- o Sites cut by man-made pipelines or aqueducts;
- o Previously unidentified inhabited buildings; and
- o Water tanks and pumps within the survey area.

2.4 FINAL LAYOUTS

Final layouts for the IOC field surveys reflect changes to the initial layout authorized by BMO/AFRCE-MX. These changes were based on the results of the environmental and/or geotechnical inspections or layout criteria changes.

2.4.1 Evaluation and Resiting Recommendations

Field evaluations were made of each shelter site, CMF, and RSS, and, in Dry Lake Valley, the DTN and Cluster 2 roads. The geotechnical factors that influenced a recommendation to resite a shelter included constructability of the site; the impact of existing terrain on the shelter, ramp, or antenna; generalized cost effectiveness of constructing a problem site versus the cost of relocating a site; and an assessment of the impact of a particular shelter location on existing hydrologic regimes. In

some cases, a large, deep wash appeared to have a major impact on a shelter site; however, the area it drained was small and highly localized. Construction of the shelter site would effectively modify the terrain so that the wash would no longer be active. In these cases, site relocations were not recommended.

Evaluations for cultural and biological resources included site-specific, valley-specific, and regional factors and are detailed in Volumes II and III of this report. The overall productivity of a valley and areal distribution, diversity, and total population of species within a valley were among the factors used to evaluate the biological significance of a particular site and to recommend resitings. A sensitive species of plant found in large numbers throughout the valley would have less of an impact on resitings than if the same species had an extremely limited occurrence. Cultural resources evaluations included the uniqueness of a particular site, its ability to be used for diagnostic or interpretative studies, or its historical value. For example, preserving a lithic scatter in a valley where such features are rare may have more importance than preserving it in a valley where such features are common. Determinations of questionable sites based on site-specific and ecosystem cultural and biological resources were made after extensive consultations with regional experts and various state, federal, and local agencies.

2.4.2 Field Reviews

A field review of specific shelter sites by geologists and engineers from Ertec Western, TRW, COE, and BMO/AFRCE was held for

each valley. The purpose of the field reviews was to become familiar with valley-specific conditions which impacted shelter layouts and DTN and road alignments. The sites were evaluated for constructability by a team of experts and final recommendations for site relocations were made. Field reviews for biological and cultural resources were made at different stages throughout the surveying and environmental inspections.

Review meetings for personnel from BMO, AFRCE, TRW, COE, Martin Marietta, Ertec Western, and other agencies were held for each valley. The purpose of these meetings was to familiarize the decision-making personnel with valley-specific conditions and present Ertec Western's recommendations for relocation of sites for cultural, biological, and/or geotechnical factors along with proposed new sites. Decisions to resite a shelter, CMF, or road segment took into account the following considerations:

- o Magnitude and ease of relocation;
- o Impact of relocation on other shelter sites;
- o Amount of additional road that would be required to reach the shelter (straight-line road layout);
- o Group intepretation of seriousness of site conditions warranting relocation; and
- o Cultural and biological conditions not known at the time of the initial layouts.

The BMO/AFRCE-MX siting requirements that were mandatory during the initial layout process were waived on a case-by-case basis during the resiting process. No attempt was made to maintain spacing criteria to backfill locations from relocated shelters. Shelters were resited outside of the suitable area boundaries

after geotechnical field studies evaluated terrain conditions and potential for shallow rock at the site. Spacing and angle criteria between primary shelters were maintained in all cases.

2.4.3 Resitings

Resitings followed the same process as initial shelter layouts. After BMO/AFRCE-MX approved site relocations, the new site was located and plotted on the 1:9600 scale maps, its location digitized, and internal checks performed to ascertain that the new location conformed to the spacing and angle criteria. The new coordinates were released to the land surveyors, and the new site was resurveyed and remonumented. All stakes and monuments from the old site were removed. Geotechnical inspections were not generally required at the new site unless the new site was located at a great distance from the old site. The new site location was chosen after adequate field reconnaissance delineated geotechnically suitable locations. New environmental clearances were required at each new location. In general, the new sites were based on translation movements relative to the old site TPB or centerline.

In many instances, an archeological site or a major wash affecting a site could be avoided by moving the rear monument to the center position and resurveying a new TPB (a net movement of 205 feet [62 m] along the centerline) or some other movement based on the shelter dimensions. Only the additional area not environmentally cleared during the initial surveys would be reinspected for these shelter sites. If a new site was relocated at some distance from the old site so the exisitng survey points

could not be used as reference points, or if the orientation of the site changed, then it was resurveyed and remonumented before the environmental, and occasionally, geotechnical clearances were made. Otherwise, if the relocations were such that the old survey points could be used as reference points, the environmental clearances could proceed concurrently with, or prior to, the resurveying.

After all the sites were located so as to optimize the geotechnical conditions and to minimize the environmental impact, the shelter locations were replotted on the 1:9600 scale topographic maps. Major changes are shown on the 1:62,500 scale topographic maps; minor changes cannot be expressed at that scale. The "as-staked" coordinates received from the land surveyors were compared to the coordinates released to them, and differences were resolved. The final coordinates provide the basis for legal descriptions of the land required by the U.S. Air Force in support of the land withdrawal application.

2.4.4 Legal Descriptions

Legal descriptions of the sites that will be withdrawn from public use are required in support of the land withdrawal application. Legal descriptions are being prepared by Ertec Airborne Systems, Inc. The preparation of legal descriptions for the withdrawal of the land required for shelter sites and certain other auxiliary structures involve determining the locations of the cadastral land net and the site, their relation to one another, and the bearing of the centerline of the site. From

this data, a metes and bounds description of the site can be written which is always related to a section corner in which the site is located (Figure 2-3).

The cadastral land net was determined by a combination of field recovered monuments defining corners of sections surveyed by BLM and calculations of positions from the township plats of the land involved. In some areas, the townships have not been surveyed by the BLM, but protraction diagrams are available. The resultant positions of a typical section corner are based on calculation and compilation.

Original monuments were found in only a small percentage of cases. Hence, the cadastral locations are tentative, for the most part, and will be subject to revision should a bona fide reestablishment by field survey be performed in the future.

All surveying and mapping information is in relation to the appropriate State Coordinate System concerned. For Dry Lake Valley, the system used is the Nevada Coordinate System, East Zone. For Pine Valley and Wah Wah Valley, the Utah Coordinate System with appropriate zone descriptions is used.

MX SITING INVESTIGATION
DRY LAKE VALLEY, NEVADA

CLUSTER: 2 SHELTER 18

LEGAL DESCRIPTION

A PORTION OF SECTION 11, TOWNSHIP 2 SOUTH, RANGE 63 EAST, MT DIABLO MERIDIAN, COUNTY OF LINCOLN,

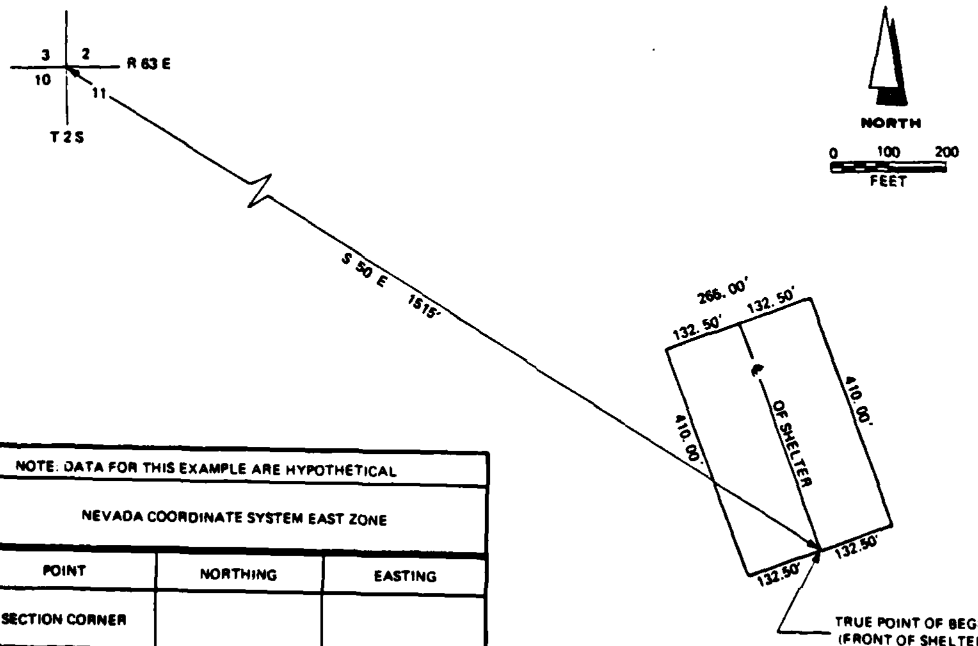
COMMENCING AT THE NORTHWEST CORNER OF SAID SECTION 11, THENCE SOUTH 50°EAST 1515 FEET TO THE TRUE POINT OF BEGINNING:

THENCE, NORTH 65°EAST	132.50 FEET;
THENCE, NORTH 25°WEST	410.00 FEET;
THENCE, SOUTH 85°WEST	265.00 FEET;
THENCE, SOUTH 25°EAST	410.00 FEET;
THENCE, NORTH 65°EAST	132.50 FEET TO THE TRUE POINT OF BEGINNING.

CONTAINING 2.49 ACRES, MORE OR LESS.

ALL BEARINGS ARE REFERRED TO THE NEVADA COORDINATE SYSTEM, EAST ZONE.
DIMENSIONS SHOWN ARE GROUND DISTANCES.

DETAIL SKETCH FOR SHELTER SITE LEGAL DESCRIPTION
VALLEY NAME: DRY LAKE VALLEY, NEVADA



NOTE: DATA FOR THIS EXAMPLE ARE HYPOTHETICAL		
NEVADA COORDINATE SYSTEM EAST ZONE		
POINT	NORTHING	EASTING
SECTION CORNER		
TRUE POINT OF BEGINNING		

DIMENSIONS AND SHAPE OF SHELTER SITE ARE SCHEMATIC CHANGES TO THE SHAPE OF THE HSS WERE MADE AFTER THE FIELD SURVEYS AND ARE NOT REFLECTED ON THIS FIGURE.

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DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

LEGAL DESCRIPTION
OF SHELTER SITE

8 JUL 81

FIGURE 2-3

3.0 DRY LAKE VALLEY

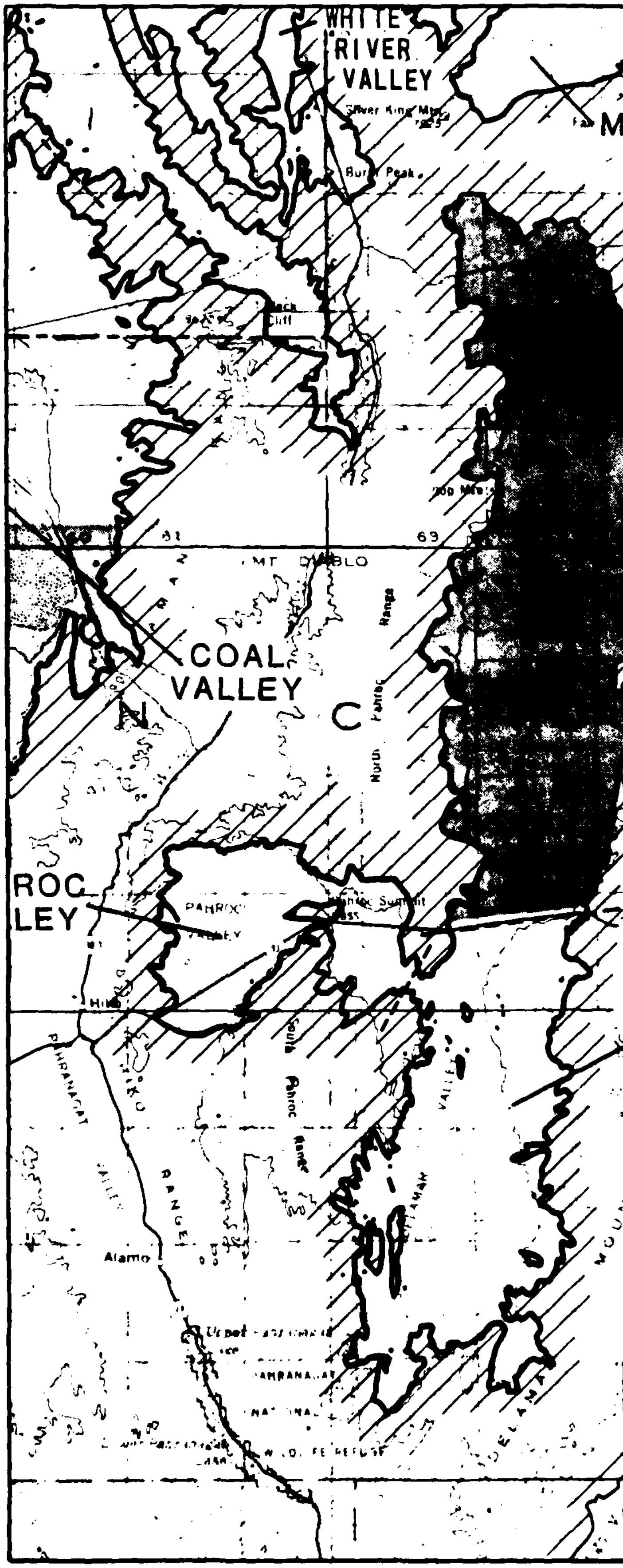
3.1 LOCATION AND CULTURAL CHARACTERISTICS

Dry Lake Valley is located in central Lincoln County, approximately 20 miles (32 km) to the west of Caliente, Nevada (Figure 3-1). It is approximately 58 miles (93 km) to the north of the proposed OB site in Coyote Spring Valley, Nevada. U.S. Highway 93 forms the southern boundary of the valley and is the only paved road in the area. Several graded county roads and four-wheel-drive trails provide access into and across the valley. The valley is mainly undeveloped desert rangeland. A few improvements, consisting of corrals, water tanks, pipelines, aqueducts, stock troughs, wells, and reservoirs are located sporadically throughout the valley.

All of the suitable area within the valleys falls under the management of the BLM with the exception of 1 1/4 sections of private land with an abandoned ranch house near Ely Springs, on the east side of the valley. Lincoln County maintains the major, graded, north-south trending roads in the north and central portions of the valley. A 137 kV rated, 69 kV carrying capacity power line follows the county road along the east of the valley.

3.2 GEOTECHNICAL CHARACTERISTICS

Dry Lake Valley is an elongate, north-south trending alluvial basin. It is bounded to the west by the North Pahroc Range which consists predominantly of carbonate rocks with minor amounts of Tertiary ash-flow tuffs (Stewart and Carlson, 1978;



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BMO/AFRCE-MX

LOCATION MAP
DRY LAKE VALLEY, NEVADA

8 JUL 81

FIGURE 3-1

and Tschantz and Pampeyan, 1970). The valley exhibits typical Basin and Range structure. High angle, normal faults, oriented north-south, border the ranges on either side of the valley with the area between them faulted downward. A north-south trending escarpment on the east side of the valley has been interpreted as a fault which cuts surface alluvium (Stewart and Carlson, 1978; Tschantz and Pampeyan, 1970; and Fugro National, Inc., 1978). Trenches across this feature did not reveal any offset (Fugro National, Inc., 1980a). Transverse faults occur at large angles to the range-bounding faults (Fugro National, Inc., 1980a; and Shawe, 1965).

Earth fissures were noted at three areas within the valley. The largest is an east-west feature noted on USGS topographic maps as "The Crack." Investigations by Ertec (1978 and 1980) indicate no offset of alluvium related to these features. The earth fissures may be caused by desiccation as the water level dropped in a Pleistocene-aged lake in the valley or by spreading or opening due to tectonic (tensional) stresses. Interpretation of gravity measurements (Fugro National, Inc., 1980b) in Dry Lake Valley suggests a transverse, strike-slip fault nearly coincident with "The Crack." Strain developed at depth during faulting may have caused the surface fissure.

Several other possible faults have been identified based on aerial photographic interpretation during a regional fault and earthquake study (Fugro National, Inc., 1980a). Some of these traces have been field verified and their locations incorporated into the siteability map used during layouts.

Basin-fill units consist of sandy gravels to silty sands comprising intermediate to younger alluvial fans and a small percentage of playa deposits in the center of the valley. Minor amounts of older alluvial fan deposits and fluvial deposits occur within the valley.

The approximate configuration of 50-foot- (15-m-) to-rock contours, used for compilation of the suitable area boundaries, was interpreted from limited point data from borings, seismic refraction surveys, site-specific published data, and depths inferred from geologic and geomorphic relationships. Shallow rock (less than 50 feet [15 m]) is interpreted to occur under approximately 20 percent of the basin-fill units.

Published data indicate ground-water levels in Dry Lake Valley exist at depths generally greater than 400 feet (122 m). An observation well drilled and monitored by Ertec Western, Inc. in 1980 recorded ground-water levels at 383 feet (117 m).

In general, only small amounts of area were designated as unsuitable during the Verification studies. The older intermediate fan areas, on the east side of the valley, had the most extreme ranges of stream incision and impacted shelter location the most. A more intensive description of the geotechnical condition is presented in FN-TR-27-DL-I and II.

3.3 LAYOUTS

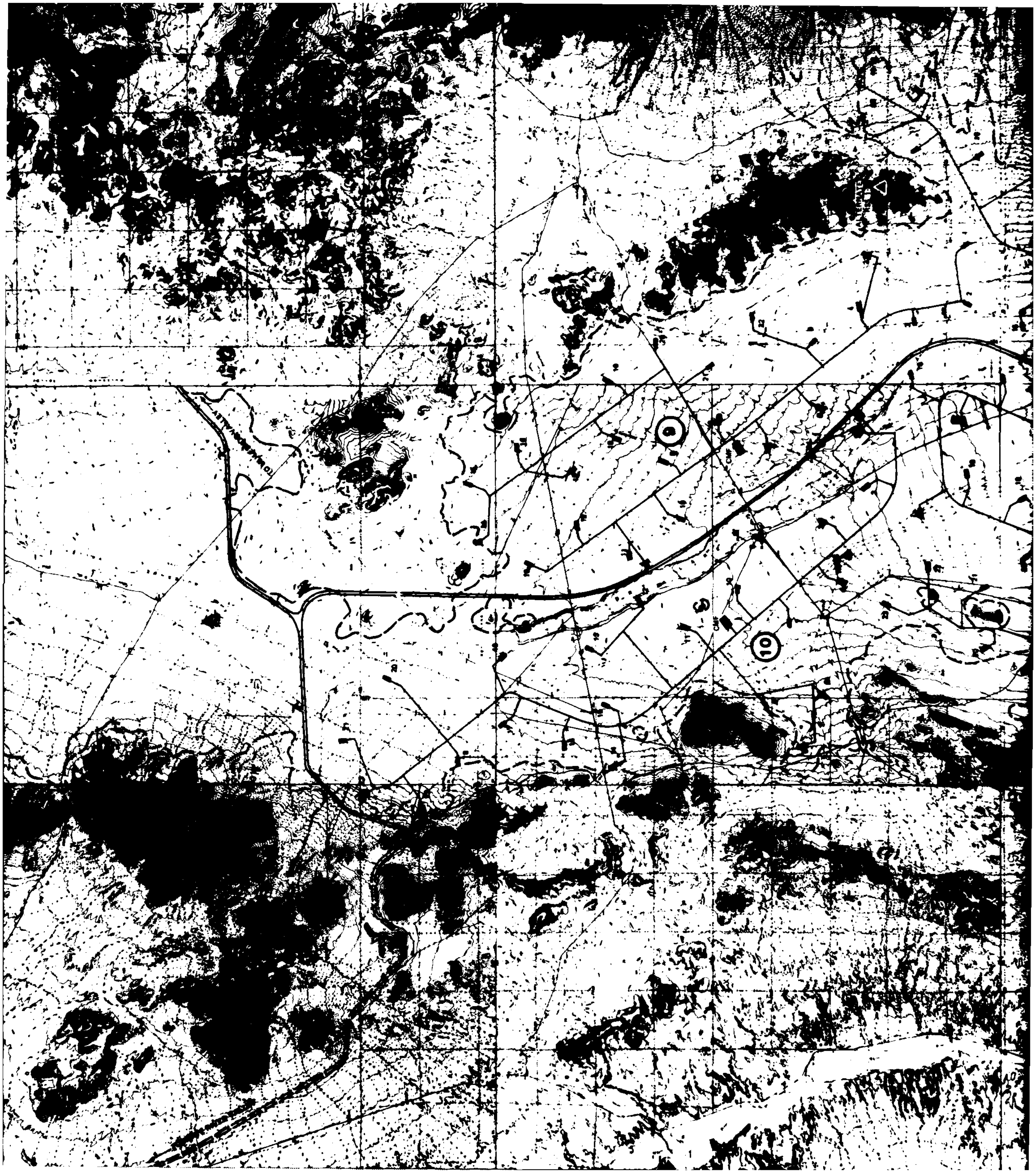
Dry Lake Valley was selected as the first area for multiple protective structures (shelter) layouts in FY 79 and was used to develop methodology and procedures. Several basing concepts and

spacing criteria were considered and tested during the preliminary studies. See Section 2.2 for a discussion of the layout procedures and chronology of studies leading to BMO/AFRCE-MX siting requirements.

3.3.1 INITIAL LAYOUTS

The suitable area for Dry Lake Valley is approximately 315 mi^2 (815 km^2). Both the northern and southern boundaries were artificially defined by Ertec Western during the Verification studies. Ten clusters, 10 CMFs, and five RSSs were located in the suitable area (Figure 3-2). Clustering was complicated by both cultural and geotechnical constraints. Cultural features that required either avoidance or a standoff (QD) as required by the BMO/AFRCE-MX were Highway 93, the power line along the east side of the valley, minor pipelines and aqueducts for livestock watering, and a ranch house and private land near Ely Springs.

Geotechnical features that required consideration were the dry lake located near the center of the valley and Coyote Wash, a major wash that runs down the center of the valley. The road network connecting the shelters, cluster roads, and trunk roads with the DTN were shown schematically on the layout plans. A straight-line design for the roads, with the main cluster road trending in a north-south direction, was the controlling factor for the road design. The average length of roads per cluster is 26 miles (42 km). The DTN was laid out to comply with BMO/AFRCE-MX criteria. Its length through the valley is 39 miles (63 km).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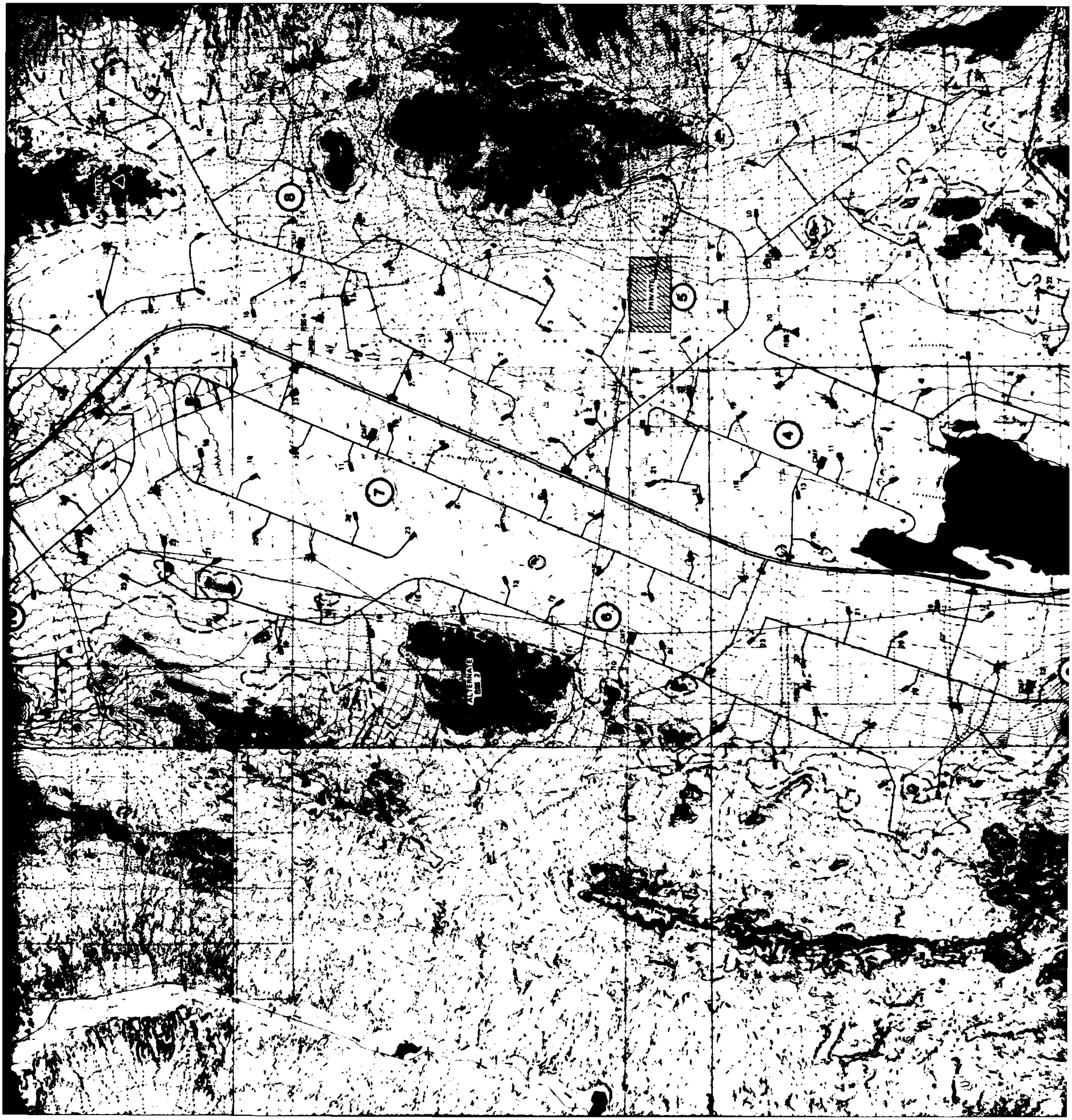
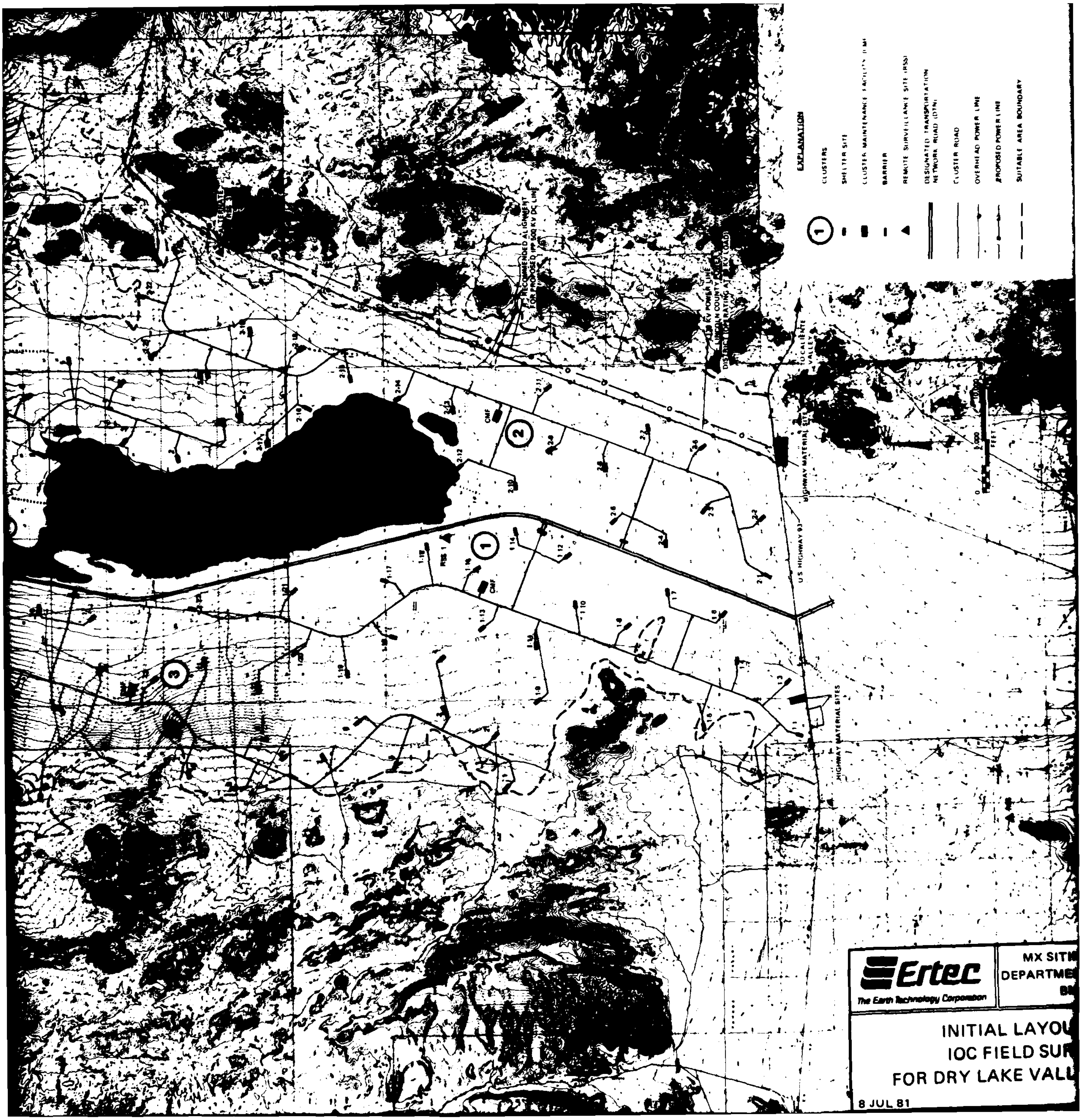
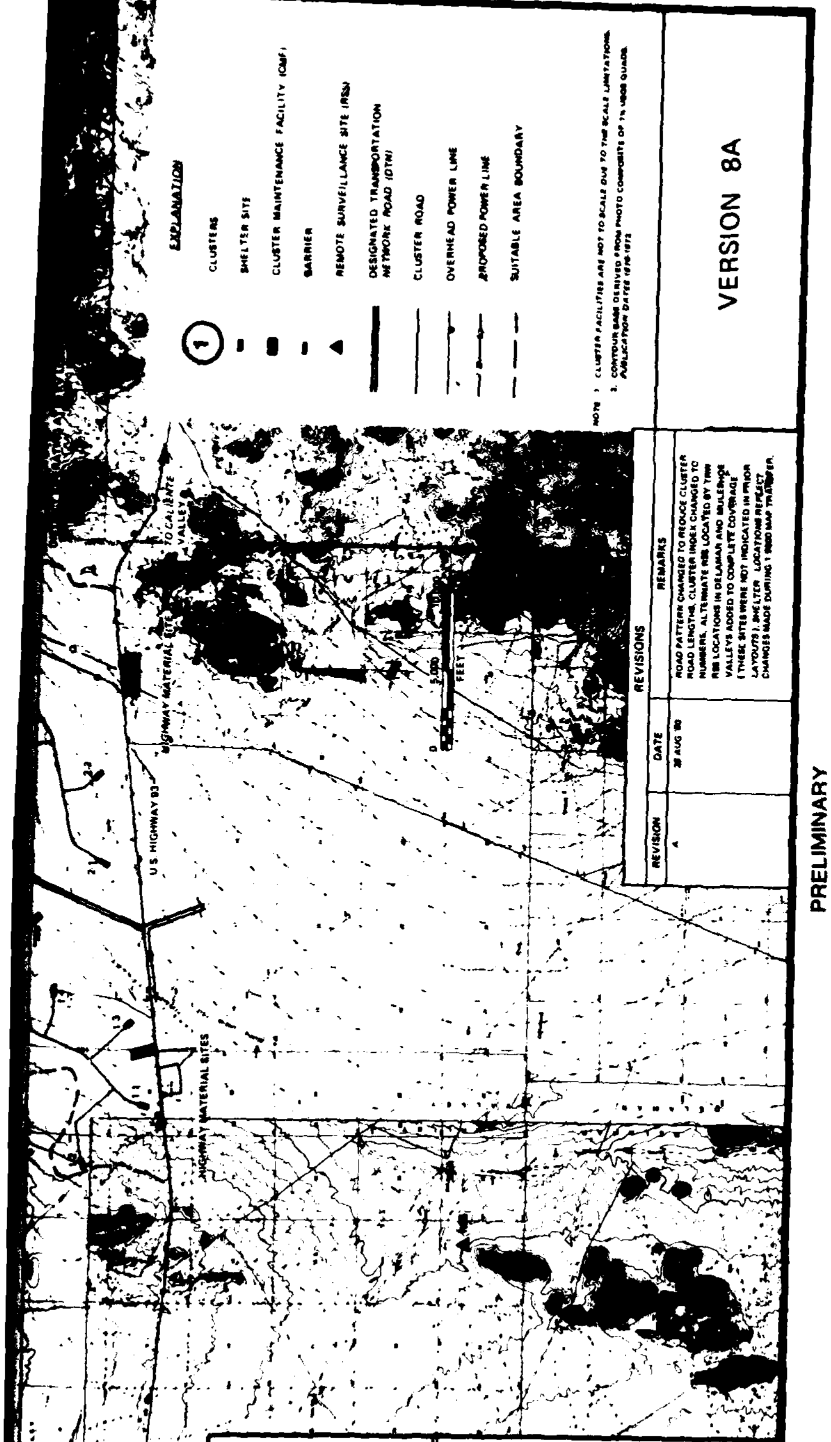




EXPLANATION
CLUSTERS
SHELTER SITE
CLUSTER MAINTENANCE FACILITY
BARRIER
REMOTE SURVEILLANCE SITE (RSS)
DESIGNATED TRANSPORTATION NETWORK ROAD (DTN)
CLUSTER ROAD
OVERHEAD POWER LINE
PROPOSED POWER LINE
SUITABLE AREA BOUNDARY
US HIGHWAY 93
HIGHWAY MATERIAL SITES
TO CALIENTE
CMF
Ertec
The Earth Technology Corporation
MX SITI
DEPARTME
INITIAL LAYOU
IOC FIELD SUR
FOR DRY LAKE VALL
8 JUL 81



PRELIMINARY
SUBJECT TO REVIEW

Ertec
The Earth Technology Corporation

MX SITING INVESTIGATION
DEPARTMENT OF THE AIR FORCE
BMO/AFRCE-MX

INITIAL LAYOUT FOR
IOC FIELD SURVEYS
FOR DRY LAKE VALLEY, NEVADA

8 JUL 81

FIGURE 3-2

After the layout was approved and transferred to the 1:9600 maps, the position of each shelter, CMF, RSS, and PIs for the DTN and Cluster 2 roads were digitized. Computer checks of the distances and angles between shelters were made to assure the layout positions complied with the siting requirements. The coordinates were then released to the land surveyors.

3.3.2 Results of Field Surveys

Environmental surveys and geotechnical inspections began on 29 September 1980 and were completed on 20 November 1980. Resurveying and environmental surveys of relocated shelter sites and approximately 5.5 miles (9 km) of the DTN were completed between 1 and 15 December 1980. The approved relocations that resulted from the field surveys in Dry Lake Valley are summarized in Table 3-1. Twenty-two sites were relocated and one site was reoriented as a result of the field surveys. Fifteen of the sites were relocated for geotechnical reasons and three for archeological reasons. No sites were relocated for biological resources. Four sites were relocated and one site was reoriented one degree to correct layout criteria violations that resulted when other sites were relocated. A summary of the magnitude of recommended and approved relocations is shown below:

Number of sites	Distance Relocated, Feet (m)
6	< 250 (<76)
5	250 - 500 (76-152)
6	500 - 1000 (152-305)
2	1000 - 1500 (305-457)
3	> 1500 (>457)

SITE	DESCRIPTION OF PROBLEM	*	MI
2-22	5 ft.- 8 ft. fault scarp trending N 10 E cuts through the environmental survey area immediately west of the shelter site	G	Shelter was moved 1300 ft. to th along the shelter centerline
2-23	Shelter site was located in the bottom of a wash and related terrace (1000 ft. wide, 30 ft. high) with a 4 ft. active wash to the south	G	Shelter was moved approximatel on top of alluvial bench
3-1	Original orientation of shelter violated angle and orientation criteria with new location of 3-5	C	Shelter was moved approximatel This large amount of movement
3-5	Locus of large lithic scatter/quarry	A	Shelter was moved approximatel This large amount of movement scatter sites occurring on the allu
4-1	3 ft. - 4 ft. deep wash crosses site perpendicular to centerline of shelter. This wash is on trend with and therefore considered to be similar to weaknesses in the ground that are expressed as large cracks or fissures	G	Shelter was moved 1000 ft. to th was required to satisfy layout cri shelter and the road from possibl
4-2	Isolated Sevier pottery, temporary camp	A	Shelter was moved 1000 ft. to th
4-3	Temporary camp	A	Shelter was moved 600 ft. to the
4-4	Original location of shelter violated spacing criteria to new shelter 4-3	C	Shelter was moved 300 ft. to the
4-22	1 ft. - 2 ft. deep, 15 ft. wide channel crosses site near TPB. This channel is continuous with extensive open feature (5 ft. - 10 ft. wide, 20 ft. deep, 1.5 miles long) known as "The Crack"	G	Shelter was moved 550 ft. to the
4-23	Original orientation of shelter violated angle criteria to new position of 4-22	C	Shelter was rotated 1° from ori
5-5	Original location of shelter violated spacing criteria to new position of 4-22	C	Shelter was moved 600 ft. to the

EXPLANATION

* A Archeological
G Geotechnical
C Criteria

* * Direction of movement relative to shelter site and does not indicate actual direction

Determination of changes of road lengt which was in effect during IOC Field Su

Net road length changes are generally le

All shelter relocations are relative to the

MITIGATION	IMPACT * *
oved 1300 ft. to the northeast ter centerline	1. Required an additional 1300 ft. of road to connect the shelter with the trunk road 2. Shelter road will cross fault scarp 3. Shelter site is bounded at each end by a small wash that will provide natural flood protection at the rear and minor construction problems at the front ramp area
oved approximately 500 ft. to the northwest, vial bench	1. Shelter and trunk roads length decreased slightly
oved approximately 3700 ft. to the west. ount of movement was required to satisfy layout criteria	1. Surveying, monumenting, and environmental clearance was required at new site 2. Trunk road length increased slightly, ~~shalter~~ road length decreased slightly
oved approximately 3 mi. south of original location. ount of movement was required to avoid several lithic ccurring on the alluvial fans on the west side of the valley	1. Trunk road length increased by approximately 0.7 mi. 2. Relocation of shelter 3-5 required relocation and resurveying of shelter 3-1 to satisfy distance criteria 3. Relocation of shelter 3-5 to backfill location ~~caused~~ shelter 3-2 to have 4 nearest neighbors (3-1, 3-3, 3-5 & 1-9)
oved 1000 ft. to the northwest. This amount of movement to satisfy layout criteria and to provide a buffer zone for the road from possible propagation of the ground cracks	1. Shelter and trunk road lengths will decrease slightly
oved 1000 ft. to the northwest	1. Shelter road length will increase slightly
oved 600 ft. to the northwest	1. Shelter road length will increase slightly 2. Relocation of shelter 4-3 required relocation and resurveying of shelter 4-4
oved 300 ft. to the southwest of original position	
oved 550 ft. to the north northeast of original position	1. Shelter road length increases slightly 2. Shelter road may cross cracks if main feature continues to propagate 3. Relocation of shelter 4-22 required relocation and resurveying of shelter 5-5 to satisfy distance criteria and shelter 4-23 to satisfy angle criteria
otated 1° from original orientation	1. Shelter was not environmentally reinspected due to minor change
oved 600 ft. to the northeast of original position	

nges of road lengths is based on original straight line road layout pattern, uring IOC Field Survey program.

ges are generally less than 500 ft., unless otherwise specified.

s are relative to the True Point of Beginning (TPB) of the surveyed site.

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SUMMARY OF SHELTER RELOCATIONS,
DRY LAKE VALLEY, NEVADA

PAGE 1 OF 2

8 JUL 81

TABLE 3-1

SITE	DESCRIPTION OF PROBLEM	*	MITI
5-9	5 ft. - 6 ft. deep, 50 ft. wide active wash trending along the centerline of the shelter	G	Shelter was moved 200 ft. to the no
5-12	2 ft. - 3 ft. deep, 10 ft. wide active wash trending close and parallel to the centerline of the shelter	G	Shelter was moved 100 ft. to the no
5-19	Wash and related terrace, 100 ft. wide with 4 ft. deep, 20 ft. wide active wash between center and rear monument	G	Shelter was moved 500 ft. to the ea
5-20	4 ft. deep, 8 ft. - 10 ft. wide active wash between the True Point of Beginning and the center monument	G	Shelter was moved 350 ft. to the no
5-22	Numerous small and intermediate active washes (1 ft. - 3 ft. deep) cut across shelter. 6 ft. deep, 10 ft. wide active wash near rear monument, with several headward eroding tributaries paralleling centerline of the shelter	G	Shelter was moved 200 ft. to the so
6-1	Numerous small and intermediate active washes (1 ft. - 5 ft. deep) within shelter and ramp area. 5 ft. deep, 150 ft. wide active wash with many drainage channels at rear monument	G	Shelter was moved 1100 ft. to the
6-2	Original location of shelter violated spacing criteria to new shelter 6-1	C	Shelter was moved 1800 ft. to the
6-18	Limestone outcrops were present at the rear of the environmental survey area. Potential for shallow rock (less than 25 ft.) at the rear of the shelter	G	Shelter was moved 250 ft. to the w
7-2	Shelter was located in close proximity of fault defined by lineation on aerial photograph and field magnetometer survey	G	Shelter was moved 205 ft. to the w
8-18	Wash and related terrace, 15 ft. deep, 200 ft. wide, with 3 ft. - 4 ft. active wash near TPB. Numerous small (1 ft. - 3 ft. deep) washes cross site. 10 ft. deep, 50 ft. wide wash with 2 ft. active channel near rear monument.	G	Shelter was moved 600 ft. to the s
8-21	10 ft. - 12 ft. deep, 100 ft. wide active wash at rear monument Small (1 ft. - 2 ft.) wash crosses site between center and rear monument	G	Shelter was moved 150 ft. to the
10-12	Rear of shelter was in close proximity to the edge of Coyote Wash (25 ft. - 30 ft. deep, 1800 ft. wide) and could have been affected by erosion of the steep slopes	G	Shelter was moved 100 ft. to the

EXPLANATION

* A Archeological
G Geotechnical
C Criteria

* * Direction of movement relative to shelter site and does not indicate actual direction

Determination of changes of road len
which was in effect during IOC Field

Net road length changes are generally

All shelter relocations are relative to

MITIGATION	IMPACT * *
d 200 ft. to the north of original position	1. Shelter road length decreased slightly
d 100 ft. to the north of original position	
d 500 ft. to the east (net movement) of original position	1. Shelter road length decreased slightly
d 350 ft. to the northwest of original position	1. Shelter road length decreased slightly
d 200 ft. to the southeast of original position	
d 1100 ft. to the east (net movement) of original position	1. Trunk road length decreased 2. Relocation of shelter 6-1 required relocation and resurveying of shelter 6-2 to satisfy spacing criteria
d 1800 ft. to the north of original position	
d 250 ft. to the west of original position	1. Shelter road length decreased slightly
d 205 ft. to the west of original position	1. Shelter road length decreased slightly
d 600 ft. to the south of original position	1. Shelter road length decreased slightly
d 150 ft. to the north of original position	1. Shelter road length decreased slightly 2. Wash to rear of shelter site may require diversion and/or channelization depending on antenna configuration
ed 100 ft. to the west of original position	1. Shelter road length decreased slightly

hanges of road lengths is based on original straight line road layout pattern, during IOC Field Survey program.

nges are generally less than 500 ft., unless otherwise specified.

ons are relative to the True Point of Beginning (TPB) of the surveyed site.

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SUMMARY OF SHELTER RELOCATIONS,
DRY LAKE VALLEY, NEVADA
PAGE 2 OF 2

8 JUL 81 TABLE 3-1

1 2

The biological and cultural resources findings for Dry Lake Valley are discussed in Volumes II (Part I) and III (Part I) of this report. Briefly summarized, no resitings were recommended for biological resources. One individual of Coryphantha vivipara, a sensitive cactus species which is now on the federal list of "Taxa Currently Under Review for Threatened and Endangered (T & E) Status," was found on approximately 15 shelter sites. Although this low density of population indicates the species is relatively rare in the valley, it was decided, after numerous consultations with state agency representatives and local academic experts, that the presence of the Coryphantha vivipara was not significant and should not impact the siting process.

Three sites warranted mitigation by avoidance due to the presence of significant archeological resources. Two sites represented the remains of temporary camps of nomadic prehistoric peoples and are located along the margins of the dry lake bed. The third site was the locus of a large lithic scatter and quarry site. The site showed evidence of depth, diagnostic artifacts, and multiple activities. Flakes and isolated artifacts probably derived from this site were found at other shelter sites along the same fan complex; however, the materials were not as concentrated or diagnostic and were not considered significant.

Geotechnical resitings resulted from siting near potentially active fault zones (two shelters), or ground cracks (two shelters), and in areas with potential for shallow rock (one

shelter) or potentially active washes (10 shelters). No CMFs or RSSs required resiting. The DTN and Cluster 2 roads were not evaluated for geotechnical aspects since the location was not based on design, but rather surveyed only to test methodology for surveying and environmental clearance. Limitations in the accuracy of plotting fault locations and therefore, the ability to avoid fault traces while siting shelters resulted from the inherent inaccuracy of the 1:62,500 map scales, inaccuracies resulting from transfer of fault locations from the color aerial photographs to the maps, and the difficulty in accurately locating fault traces in the field during ground surveys.

Shelter 2-22 was located in close proximity to a prominent fault scarp that was difficult to recognize as a fault on the detailed topographic maps (Figure 3-3). The shelter was relocated approximately 1000 feet (310 m) from the scarp on the upthrown block. The road to the shelter will cross the scarp and fault zone. The fault near Shelter 7-2 was identified from aerial photographic interpretation and verified by a magnetometer survey. There was little to no topographic expression of the fault. Shelters 4-1 and 4-22 are on trend with large ground cracks or fissures. The fissures vary from 2 to 15 feet (0.6 to 5 m) deep and 1 to 8 feet (0.3 to 2 m) wide (Figure 3-4). There is no evidence of offset along these features. The cracks or fissures propagate in a generally straight or slightly arcuate manner. Although the cracks are thought to present a construction nuisance rather than impacting the structural integrity of

AERIAL VIEW OF FAULT SCARP ON EAST SIDE OF DRY LAKE VALLEY.

GROUND VIEW OF FAULT SCARP ON EAST SIDE OF DRY LAKE VALLEY.

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FAULT SYSTEM ON EAST SIDE OF DRY LAKE VALLEY

8 JUL 81 FIGURE 3.3

LARGE SCALE DESICCATION CRACKS IN DRY LAKE VALLEY (NOTE PERSON TO THE LEFT FOR SCALE).

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DESICCATION CRACKS,
DRY LAKE VALLEY

8 JUL 81

FIGURE 3.4

the shelter, it was considered easier and safer to relocate the shelter sites at this time.

Of the 10 shelter sites relocated because of potentially active washes, three were relocated because the wash appeared to impact the shelter door or ramp area, one because of potential problems with the conceptual antenna design, and six because the wash impacted the shelter itself. In all cases, the site could have been constructed as staked, but relocations will reduce the number of drainage structures and grading required for drainage control.

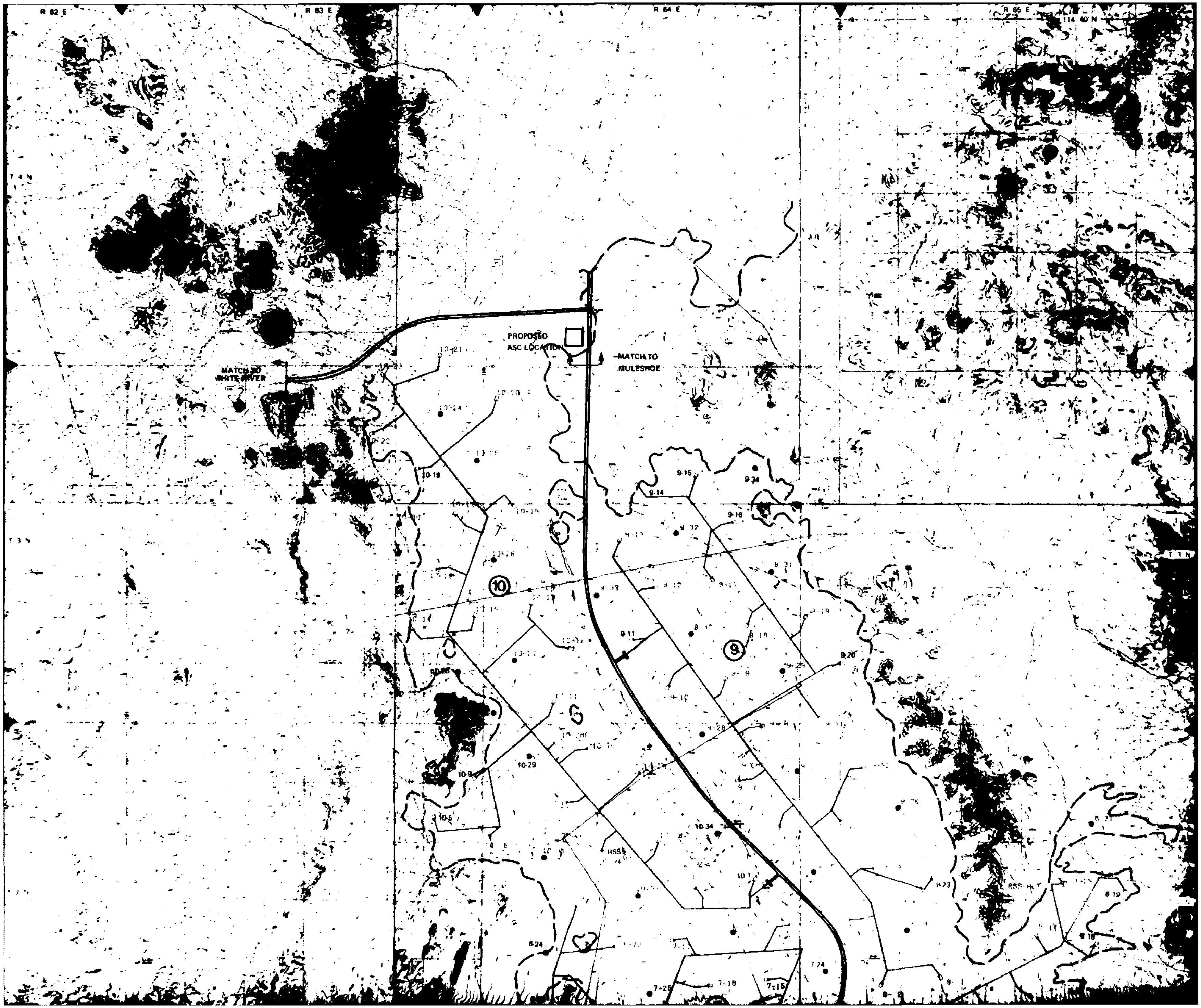
3.3.3 Final Layouts

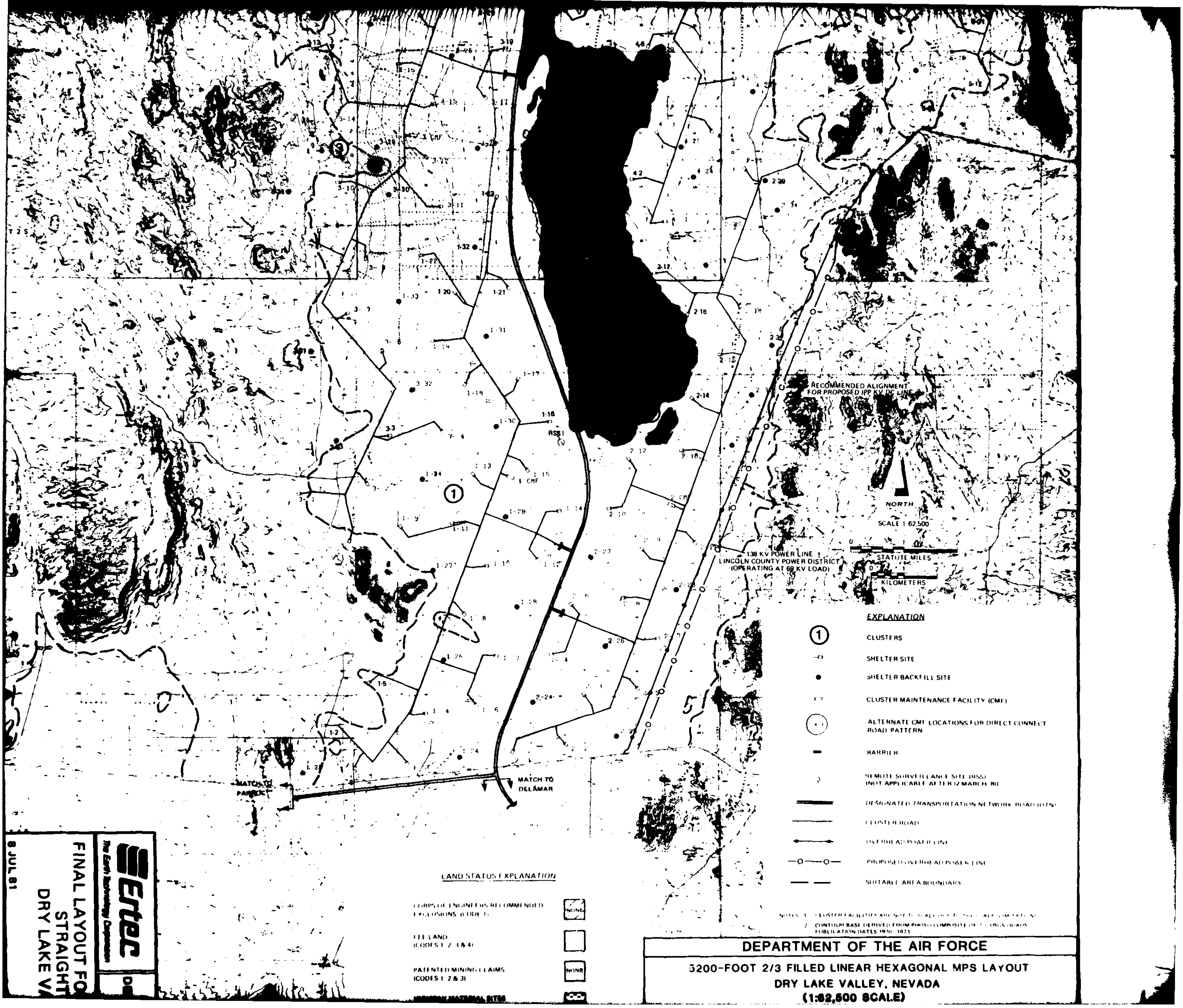
The final "as-staked" layout of Dry Lake Valley is shown as Figure 3-5. Many of the relocations are not apparent at this map scale. The map reflects the criteria waivers approved by BMO/AFRCE-MX at the 12 November 1980 site review meeting.

Waivers of criteria include:

- Siting two shelters outside of suitable area boundary (southern end of Cluster 3);
- One shelter with four nearest neighbors (southern end of Cluster 3): and
- Violation of spacing to backfills (15 shelters).

Approximately 5.5 miles (9 km) of the DTN were rerouted due to a series of archeological sites along the Dry Lake margin. The DTN alignment was shifted between 200 and 1600 feet (61 to 488 m) to avoid these sites. The new alignment required three additional PIs (three additional curved segments); this was


R 62 E
R 63 E
R 64 E
R 65 E
T 4 N
T 3 N
PROPOSED
ASC LOCATION
MATCH TO
MULESHOE
MATCH TO
WHITE RIVER
10
9


RECOMMENDED ALIGNMENT FOR PROPOSED IPP KV DC LINE
NORTH
SCALE 1:62,500
STATUTE MILES
KILOMETERS
138 KV POWER LINE
LINCOLN COUNTY POWER DISTRICT
(OPERATING AT 69 KV LOAD)
MATCH TO DELAMAR
MATCH TO PAHROC
EXPLANATION
CLUSTERS
SHELTER SITE
SHELTER BACKFILL SITE
CLUSTER MAINTENANCE FACILITY (CMF)
ALTERNATE CMF LOCATIONS FOR DIRECT CONNECT ROAD PATTERN
BARRIER
REMOTE SURVEILLANCE SITE (RSS) (NOT APPLICABLE AFTER 12 MARCH 80)
DESIGNATED TRANSPORTATION NETWORK ROAD (DTN)
CLUSTER ROAD
OVERHEAD POWER LINE
PROPOSED OVERHEAD POWER LINE
SUITABLE AREA BOUNDARY
LAND STATUS EXPLANATION
CORPS OF ENGINEERS RECOMMENDED EXCLUSIONS (CODE 1)
NONE
FEE LAND (CODES 1, 2, 3 & 4)
PATENTED MINING CLAIMS (CODES 1, 2 & 3)
NONE
2. CONTOUR BASE DERIVED FROM PHOTO COMPOSITE OF USGS QUADS PUBLICATION DATES 1970 - 1971
DEPARTMENT OF THE AIR FORCE
3200-FOOT 2/3 FILLED LINEAR HEXAGONAL MPS LAYOUT
DRY LAKE VALLEY, NEVADA
(1:62,500 SCALE)
Ertec
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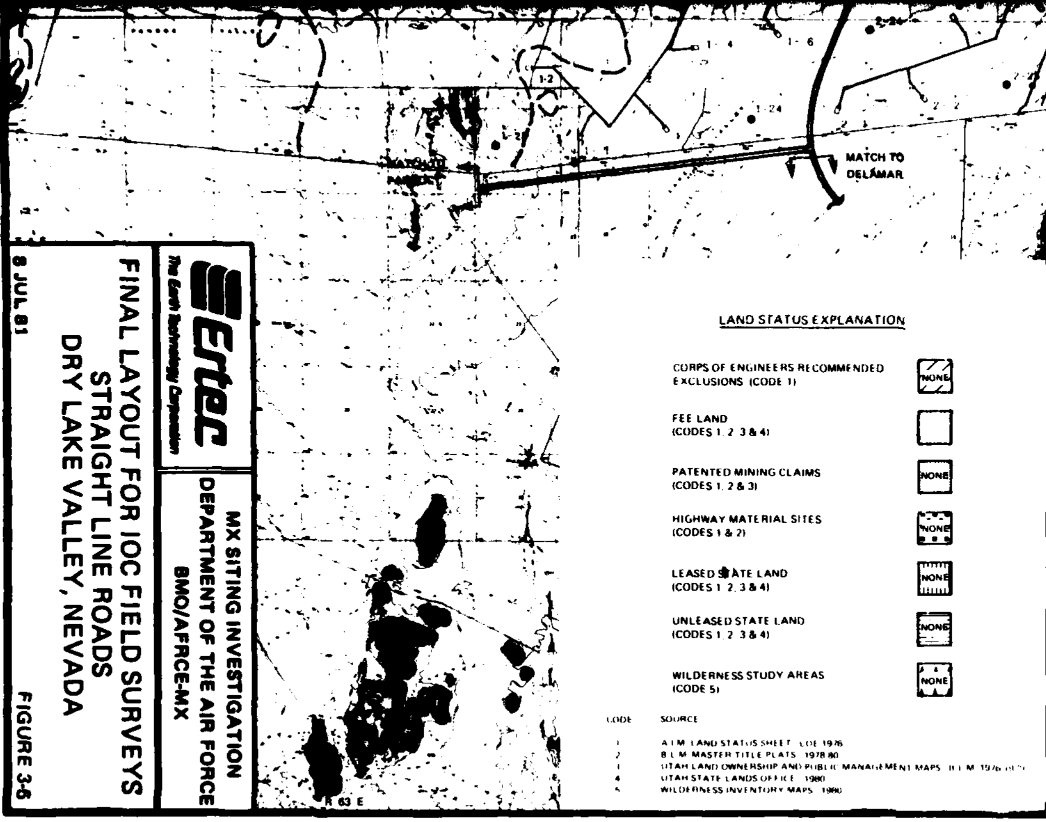
FINAL LAYOUT FO
STRAIGHT
DRY LAKE V
8 JUL 81



CLUSTER MAINTENANCE FACILITY (CMF)

ALTERNATE CMF LOCATIONS FOR DIRECT CONNECT ROAD PATTERN

BARRIER

REMOTE SURVEILLANCE SITE (RSS) (NOT APPLICABLE AFTER 17 MARCH, 81)

DESIGNATED TRANSPORTATION NETWORK ROAD (DTN)

CLUSTER ROAD

OVERHEAD POWER LINE

PROPOSED OVERHEAD POWER LINE

SUITABLE AREA BOUNDARY

NOTES 1. CLUSTER FACILITIES ARE NOT TO SCALE DUE TO THE SCALE LIMITATIONS

2. CONTOUR BASE DERIVED FROM PHOTO COMPOSITE OF 7½ USGS QUADS PUBLICATION DATES 1970 - 1973.

LAND STATUS EXPLANATION

CORPS OF ENGINEERS RECOMMENDED EXCLUSIONS (CODE 1) — NONE

FEE LAND (CODES 1, 2, 3 & 4)

PATENTED MINING CLAIMS (CODES 1, 2 & 3) — NONE

HIGHWAY MATERIAL SITES (CODES 1 & 2) — NONE

LEASED STATE LAND (CODES 1, 2, 3 & 4) — NONE

UNLEASED STATE LAND (CODES 1, 2, 3 & 4) — NONE

WILDERNESS STUDY AREAS (CODE 5) — NONE

CODE	SOURCE
1	A.I.M. LAND STATUS SHEET LOE 1976
2	B.L.M. MASTER TITLE PLATS 1978-80
3	UTAH LAND OWNERSHIP AND PUBLIC MANAGEMENT MAPS B.L.M. 1976-1979
4	UTAH STATE LANDS OFFICE 1980
5	WILDERNESS INVENTORY MAPS 1980

DEPARTMENT OF THE AIR FORCE

5200-FOOT 2/3 FILLED LINEAR HEXAGONAL MPS LAYOUT
DRY LAKE VALLEY, NEVADA
(1:62,500 SCALE)

REVISIONS	DATE	REMARKS	APPROVED BY	SIGNATURE	DATE
		SHELTERS, BACKFILLS, CMF'S, RSS LOCATIONS ARE AS SURVEYED IN THE FIELD SCHEMATIC ROAD PATTERN DEPICTED IS CONVENTIONAL CRN	Ertec		
			HDR		
			TRW		
			AFRCE		
			BMO		

REVISIONS

AIR FORCE REGIONAL CIVIL ENGINEER-MX
NORTON AIR FORCE BASE, SAN BERNARDINO,
CALIFORNIA 92409

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FINAL LAYOUT FOR IOC FIELD SURVEYS
STRAIGHT LINE ROADS
DRY LAKE VALLEY, NEVADA

8 JUL 81

FIGURE 3-6

PRELIMINARY
SUBJECT TO REVISION

4

necessary to conform to QD requirements between the DTN and shelters and to allow enough of a standoff to avoid the archeological sites.

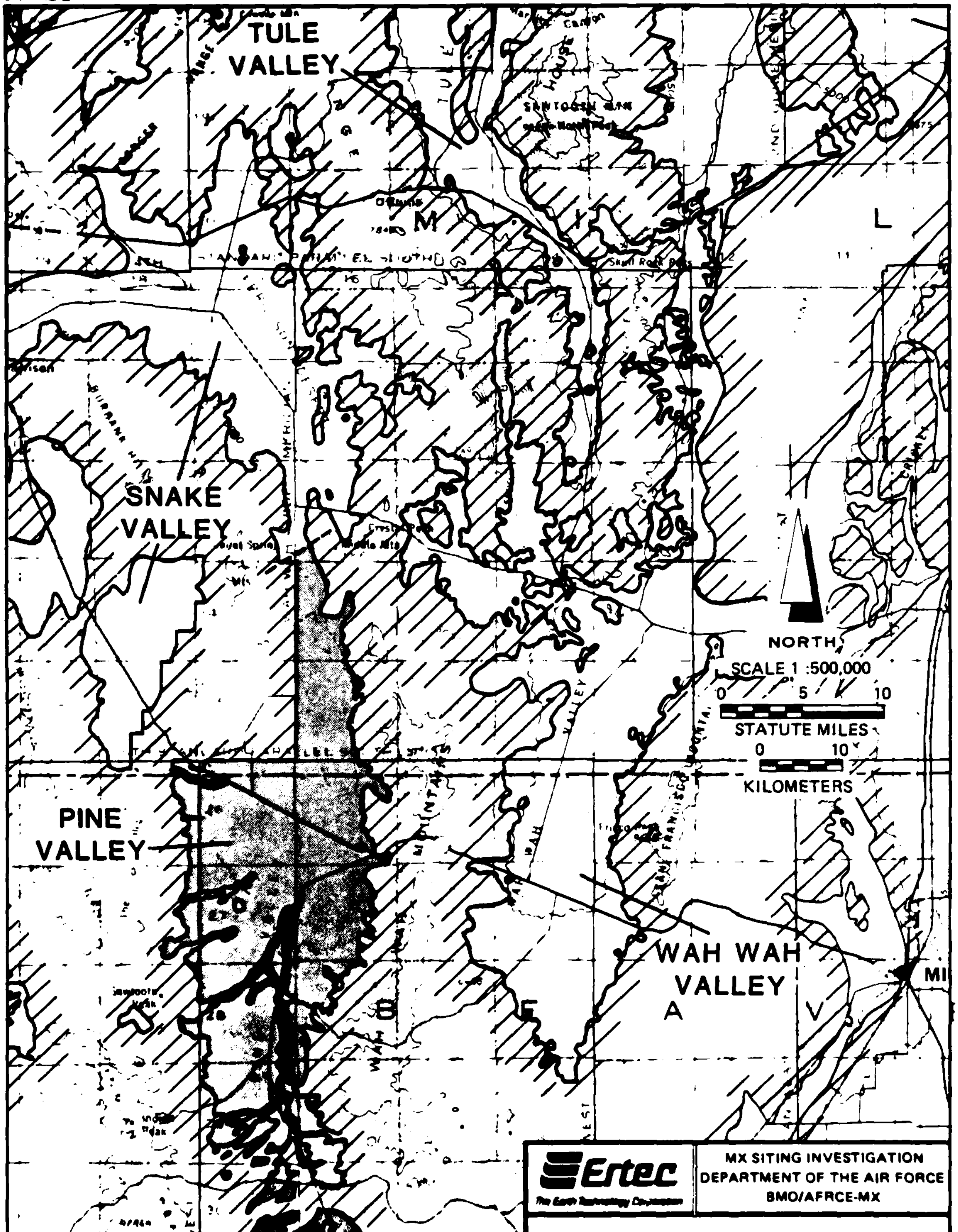
Legal descriptions of the land at shelters and CMF sites shown in Figure 3-5, and right-of-way alignments for the roads network will be prepared as part of the land withdrawal application.

4.0 PINE VALLEY

4.1 LOCATION AND CULTURAL CHARACTERISTICS

Pine Valley is located in western Beaver and Millard counties, Utah, approximately 36 miles (58 km) west of Milford (Figure 4-1). The valley is bounded by mountains to the east and west.

Snake Valley is contiguous with Pine Valley to the north. Bedrock, highly dissected alluvial fans, and the Pine Valley Wash form the southern boundary of the suitable area. State Highway 21 runs diagonally northwest-southeast across the north-central portion of the valley. Access into the valley is by graded roads, mostly utilized by mining concerns, and four-wheel-drive trails. The land is mainly undeveloped and utilized for cattle and sheep grazing. Many improvements to the rangeland including water tanks, stock troughs, corrals, reservoirs, pipelines, and aqueducts have been made by the ranchers. The western bench areas between Antelope and Turkey washes have been cleared of the native pinyon-juniper vegetation, planted with crested wheatgrass, and used as a summer range for livestock. The Desert Experimental Range, operated by the University of Utah Research Institute, is located in the northwest corner of the valley. A molybdenum mine has been proposed for the Pine Grove area in the Wah Wah Mountains to the east of the valley. Three wildcat wells are being drilled for oil and gas exploration. One was being drilled north of Cow Camp well during the field surveys; the location of the other two wells is not known. A materials site and several gravel pits occur along Highway 21.



LOCATION MAP
PINE VALLEY, UTAH

8 JUL 81

FIGURE 4-1

The land in Pine Valley is divided between leased and unleased state land (generally sections 2, 16, 32, and 36 of each township), unpatented mining claims, and fee land. The Indian Peak State Game Management Area is located in the west part of the valley and there is a small pinyon study area to the east.

4.2 GEOTECHNICAL CHARACTERISTICS

The north-south trending Pine Valley is bounded in the east by the Wah Wah Mountains, predominantly Paleozoic limestones, dolomites, and quartzites, with minor amounts of younger volcanic rocks (Hintze, 1963). To the south of the range, the volcanics become dominant. The Tunnel Spring Mountains, Indian Peak Range, and the Needles, to the west, are almost exclusively Tertiary volcanic dacite and ash-flow tuff. Minor amounts of Tertiary (?) caliche-cemented fanglomerates are exposed along the western margin of the alluvial basin-fill deposits.

The down-dropped central portion of the valley is the result of late Tertiary-Quaternary block faulting. Major faults are found along the valley margins at the base of the mountain ranges. A subsurface fault, shown on the geologic map for southwestern Utah (Hintze, 1963), is inferred under the alluvium near the base of the Wah Wah Mountains. No surface expression of this feature was noted during field investigations, and, if present, is thought to be older than late Quaternary in age.

Quaternary faults, which cut the alluvial units, are found near the center and the southern end of the valley. The faults

are expressed mainly as vegetation lineaments with little or no topographic relief.

Alluvial fans of intermediate age are the predominant basin-fill deposits within the valley. The soil type ranges from sandy gravels near the mountains to sandy silts near the center of the valley. The valley axis is composed of young fluvial sediments. Playa deposits are found in the north-central portion of the valley.

The approximate configuration of the 50-foot- (15-m-) to-rock contours, used for compilation of the suitable area boundaries, is based on limited point data from borings, seismic refraction surveys, site-specific published data, and depths inferred from geologic and geomorphic relationships. Shallow rock (less than 50 feet [15 m]) is interpreted to occur under approximately 13 percent of the alluvial units.

Published well information indicated that ground water exists at depths generally greater than 300 feet (91 m). Observation wells drilled by Ertec in 1979 and 1980 showed water depths ranging from 340 to 443 feet (104 to 135 m).

The deeply incised tributaries to Pine Valley Wash (Turkey, Antelope, Cottonwood, and Jackson washes and Indian, Commissary, and Sheep creeks) as well as the southern portions of Pine Valley Wash itself are excluded from the geotechnically suitable area based on their depth and width. Relatively small amounts of area, excluded due to excessive slope, occur mainly on the

western margins of the valley. A more detailed description of the geotechnical conditions is presented in FN-TR-27-PI-I and II.

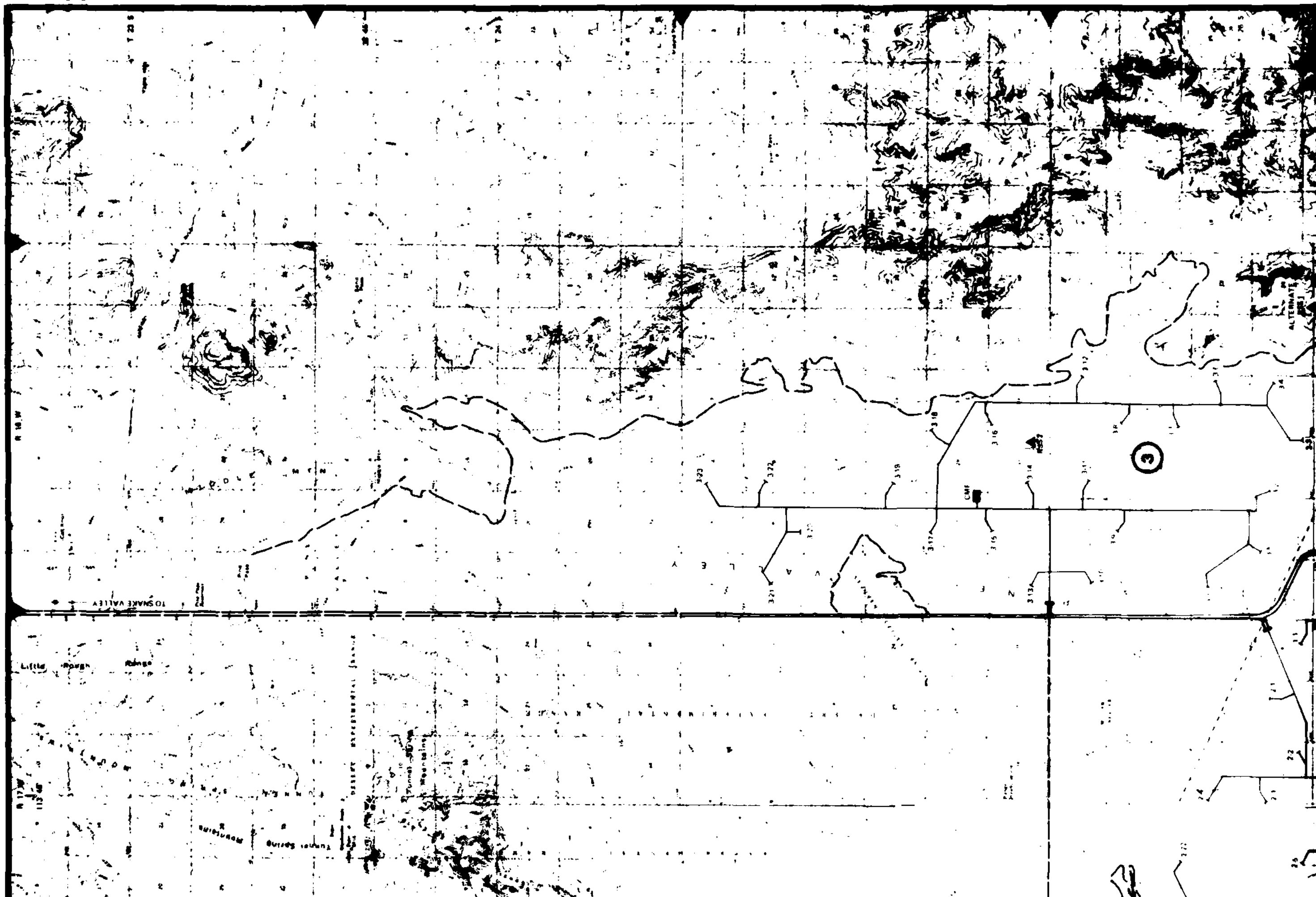
4.3 LAYOUTS

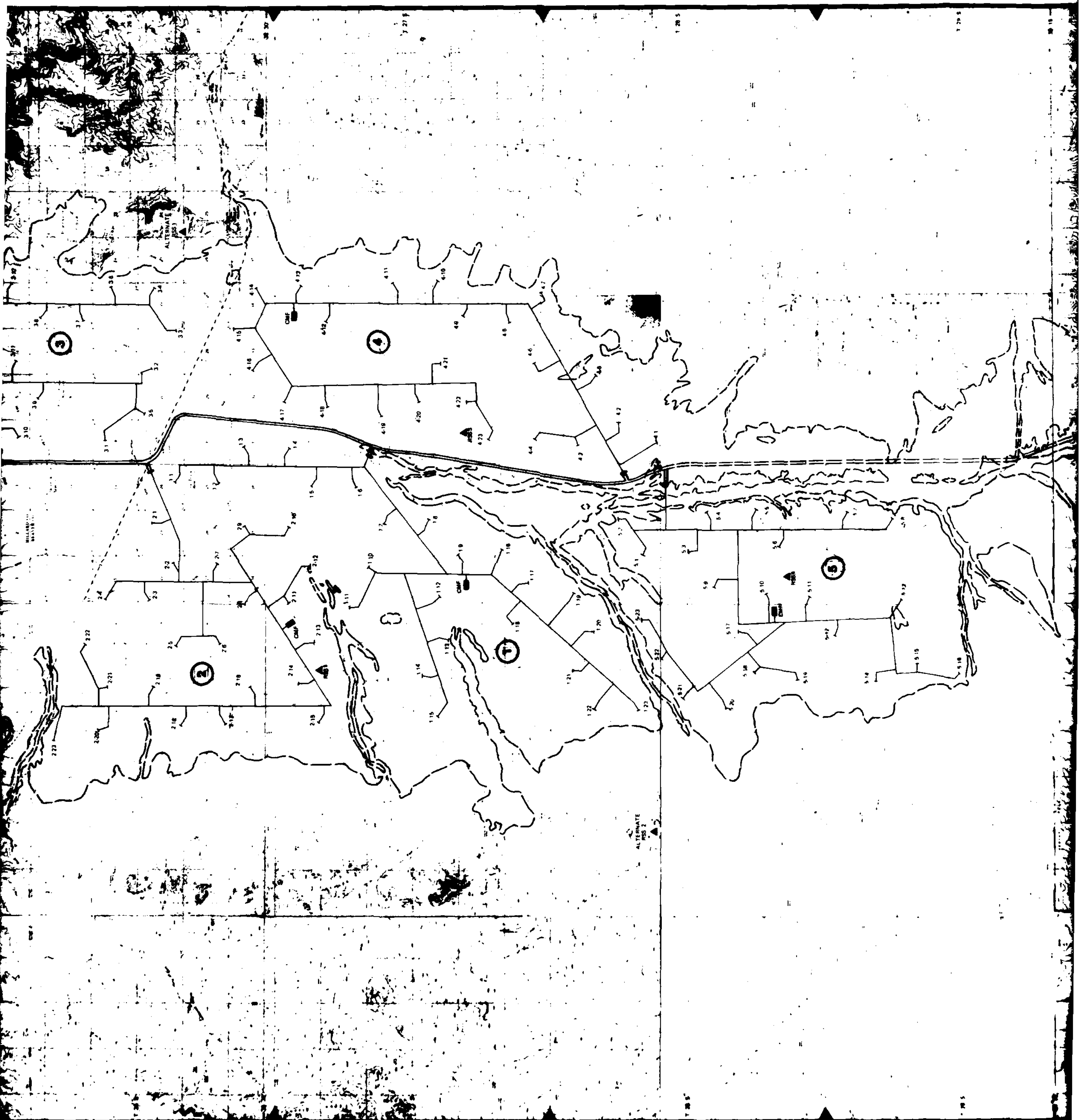
Pine Valley, in conjunction with Wah Wah Valley, was chosen as the IOC area in Utah due to its location near the proposed OB sites in the Beryl-Milford area.

4.3.1 Initial Layouts

The northern boundary of Pine Valley with Snake Valley was artificially defined by Ertec Western during Verification studies. Part of the western boundary is defined by the Desert Experimental Range; the suitable area boundaries define the rest of the valley. Cultural constraints to clustering include the Desert Experimental Range and Utah State Highway 21. Geotechnical constraints include the Pine Valley Hardpan, Pine Valley Wash and large, deep tributaries to it, and shallow volcanic rocks along the western margin of the valley. Several layouts were prepared for Pine Valley prior to approval of the final layout by BMO/AFRCE-MX (Figure 4-2). Five clusters, five CMFs, and four RSSs were located in the 265 mi^2 (686 km^2) of suitable area. The DTN shown on the base maps used for the IOC field surveys was based on an OB in the Beryl-Milford area. The road network is based on straight-line segments with cluster roads trending north-south if possible.

After the layout was approved and transferred to the 1:9600 scale maps, the position of each shelter, CMF, and RSS was





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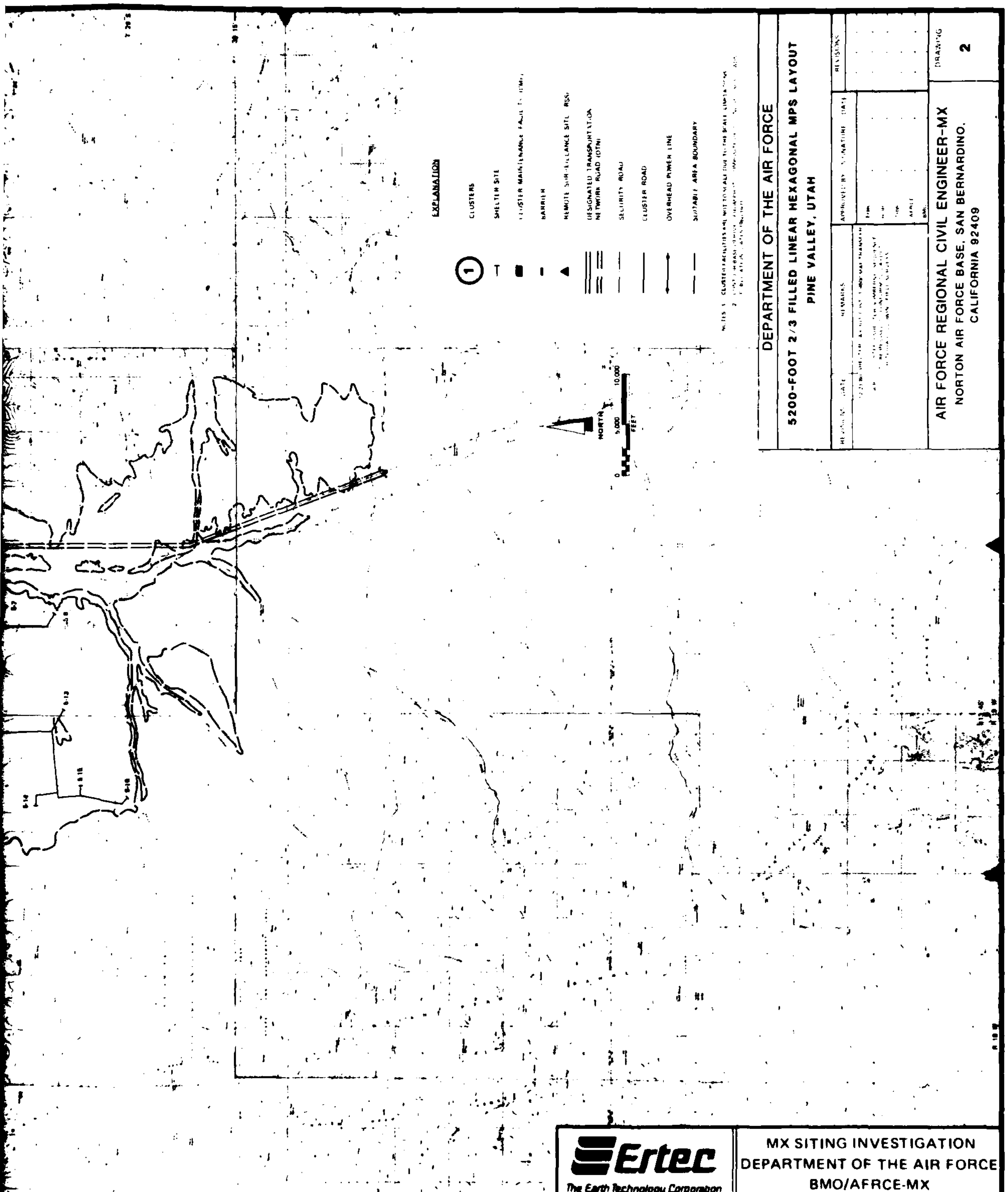

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INITIAL LAYOUT FOR
IOC FIELD SURVEYS
PINE VALLEY, UTAH

8 JUL 81

FIGURE 4-2

PRELIMINARY
SUBJECT TO REVISION

digitized. Computer checks of distances to and angles between each shelter were made to assure the layout positions complied with the siting requirements.

4.3.2 Results of Field Surveys

Environmental surveys and geotechnical inspections of Pine Valley began on 10 November 1980 and were completed 20 December 1980. Resurveying relocated sites occurred between 2 and 15 March 1981. Weather conditions were variable during the field surveys with several days lost due to rain, snow, and/or dense fog. The approved relocations that resulted from the field surveys are summarized in Table 4-1. Twenty-two sites were relocated: 16 for geotechnical reasons, one for archeological reasons, one for biological reasons, one to satisfy criteria resulting from other site relocations, and three for cultural reasons. The magnitudes of site relocations are summarized below:

Number of Sites	Distance Relocated, Feet (m)
8	< 250 (<76)
8	250 - 500 (76-152)
2	500 - 1000 (152-305)
0	1000 - 1500 (305-457)
4	> 1500 (>457)

The cultural and biological findings for Pine Valley are discussed in separate volumes of this report. Briefly, one site was recommended and approved for resiting due to biological resources. The site had 32 cacti plants, identified as Coryphantha vivipara, on it. This species is considered sensitive and is presently on the list of "Taxa Currently Under Review for

SITE	DESCRIPTION OF PROBLEM	*	MIT
1-1	Large lithic scatter	A	Shelter was moved 265 ft. to the
1-14	6 ft. deep wash, 2 ft. - 3 ft. deep active channel located at TPB	G	Shelter was moved 205 ft. to th
1-21	6 ft. - 8 ft. wash, active channels located at rear monument	G	Shelter was moved 205 ft. to th
1-22	50 ft. - 100 ft. wide, active channel located at TPB; narrower active drainage located at the rear monument	G	Shelter was moved approximatel
2-13	500 ft. wide, 15 ft. - 20 ft. deep wash, with active drainages and sheet flooding located at the rear monument	G	Shelter was moved approximatel
2-14	40 ft. wide, 3 ft. - 4 ft. deep wash, with active drainages located at the rear monument	G	Shelter was moved 205 ft. to the
2-15	10 ft. - 20 ft. wide, 5 ft. - 6 ft. deep, extremely active wash intersected ramp area of shelter. Smaller drainages, 6 ft. wide, 3 ft. - 4 ft. deep with 1 ft. active incision at center and rear monuments	G	Shelter was moved 800 ft. to the
2-18	100 ft. wide, 3 ft. - 4 ft. deep wash 50 ft. from rear monument that would affect antenna as presently conceptualized	G	Shelter was moved 205 ft. to the
3-7	Numerous 6 ft. wide, 5 ft. deep active washes cut across shelter parallel to centerline	G	Shelter was moved 410 ft. to the
3-9	6 ft. wide, 5 ft. - 6 ft. deep wash with 1 ft. - 2 ft. deep active incision cut across site parallel to centerline	G	Shelter was moved 205 ft. to the
3-10	Shelter site was located within the boundary of a large active playa	G	Shelter was moved to the north
3-13	Relocation of shelter 3-10 isolated shelter 3-13 and required a long road segment to connect this shelter with the trunk road	C	Shelter was moved to the north
3-16	6 ft. wide, 6 ft. deep wash with 2 ft. deep active incision cuts across site 5 ft. deep wash located near rear monument	G	Shelter was moved 410 ft. to th
4-5	2 ft. - 3 ft. deep man-made ditch cuts across site perpendicular to centerline.	Cu	Shelter was moved 205 ft. to th

EXPLANATION

* A Archeological
G Geotechnical
C Criteria
Cu Cultural

** Direction of movement relative to shelter site and does not indicate actual direction.

Determination of changes of road l
which was in effect during IOC Fi

Net road length changes are genera

All shelter relocations are relative t

MITIGATION	IMPACT * *
moved 265 ft. to the southwest	
moved 205 ft. to the north	1. Shelter road length increased slightly
moved 205 ft. to the south	1. Shelter road length decreased slightly
moved approximately 400 ft. to the north northwest	1. Shelter road length increased
moved approximately 400 ft. to the northeast	1. Shelter road length decreased slightly
moved 205 ft. to the south	1. Shelter road length decreased slightly
moved 800 ft. to the south southeast, reoriented to N 22 W	1. Shelter road length increased 2. Relocation required reorientation to avoid angle criteria violation
moved 205 ft. to the southeast	1. Shelter road length decreased slightly
moved 410 ft. to the south southeast	
moved 205 ft. to the southeast	1. Shelter road length decreased slightly
moved to the north end of the cluster	1. Relocation of shelters 3-10 and 3-13 shortened road length by 0.2 mi.
moved to the north end of the cluster	1. Relocation of shelters 3-10 and 3-13 shortened road length by 0.2 mi. 2. Decision to relocate shelter 3-13 for criteria reasons required surveying and inspecting an additional site
moved 410 ft. to the northeast	1. Shelter road length decreased slightly
moved 205 ft. to the northwest	1. Shelter road length decreased slightly

of changes of road lengths is based on original straight line road layout pattern, ffect during IOC Field Survey program.

h changes are generally less than 500 ft., unless otherwise specified.

ocations are relative to the True Point of Beginning (TPB) of the surveyed site.

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SUMMARY OF SHELTER RELOCATIONS, PINE VALLEY, UTAH
PAGE 1 OF 2

8 JUL 81

TABLE 4-1

SITE	DESCRIPTION OF PROBLEM	*	MITIGAT
4-6	1 ft. - 3 ft. deep man-made ditch cuts across the site between the center and rear monuments	Cu	Shelter was moved 600 ft. to the north
4-7	Large number of sensitive flora on site	B	Shelter was moved approximately 400
4-9	4 ft. - 5 ft. deep wash with 1 ft. - 4 ft. deep active incision cuts across site near TPB and ramp area. Smaller wash cuts across site between center and rear monuments	G	Shelter was moved 205 ft. to the south
4-11	10 ft. - 15 ft. deep, 6 ft. - 10 ft. wide wash with 3 ft. deep active incision cuts across site behind rear monument, affecting antenna as presently conceptualized. Smaller washes 3 ft. wide, 5 ft. - 6 ft. deep near center and rear monuments	G	Shelter was moved 300 ft. to the south
5-1	500 ft. wide, 5 ft. deep wash with many localized active areas cuts across site between center and rear monument	G	Shelter was moved 300 ft. to the south
5-2	25 ft. deep, wide wash with many localized active areas cuts across site between the center and rear monuments. Close to axial Pine Valley wash	G	Shelter was moved 205 ft. to the south
5-3	6 ft. tall water tank located in close proximity to TPB	Cu	Shelter was relocated to the southern
5-8	Fault identified on color aerial photographs by vegetation alignments. Break in slope apparent on the ground	G	Shelter was moved approximately 200

EXPLANATION

* A Archeological
G *Geotechnical*
C *Criteria*
Cu *Cultural*

** Direction of movement relative to shelter site and does not indicate actual direction

Determination of changes of road length which was in effect during IOC Field Su

Net road length changes are generally l

All shelter relocations are relative to the

MITIGATION	IMPACT * *
d 600 ft. to the northwest and reoriented to N 69 E	1. Trunk road length will probably shorten slightly
d approximately 400 ft. to the southeast	1. Shelter and trunk road lengths may increase
d 205 ft. to the southwest	1. Shelter road length decreased slightly
d 300 ft. to the southwest	1. Shelter road length decreased slightly
d 300 ft. to the southeast and reoriented to N 44 W	1. Shelter road length will probably remain the same 2. Relocation required reorientation to avoid angle criteria violation
d 205 ft. to the south	1. Shelter road length decreased slightly
ated to the southern end of Cluster 5, near shelter 5-13	1. Shelter road length was increased by approximately 0.5 mi
d approximately 2000 ft. to the south	1. Trunk and shelter road lengths increased 2. Road will still cross fault zone

nges of road lengths is based on original straight line road layout pattern,
during IOC Field Survey program.

nges are generally less than 500 ft., unless otherwise specified.

ns are relative to the True Point of Beginning (TPB) of the surveyed site.

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SUMMARY OF SHELTER RELOCATIONS,
PINE VALLEY, UTAH
PAGE 2 OF 2

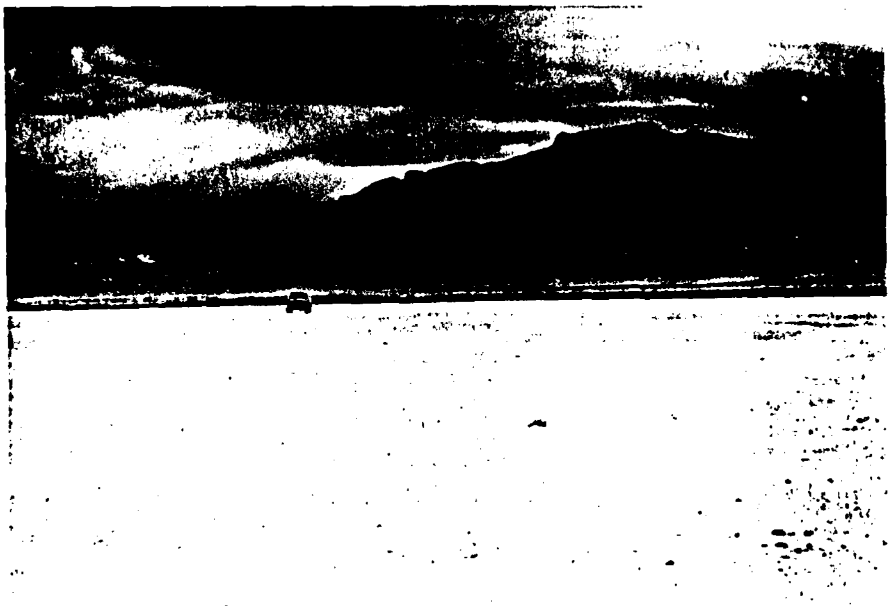
8 JUL 81 TABLE 4-1

2

Threatened and Endangered Status." Five other sites were recommended for relocation by Ertec Northwest; relocations of these sites would have added substantially to the road lengths and were not approved by BMO/AFRCE-MX at the 12 March 1981 environmental review meeting. Two sites were recommended for relocation for archeological findings. Mitigation by avoidance was possible for one site, and its relocation was approved. Relocation of the other site to a proximal location was not possible due to spacing limitations between shelters and the QD to the DTN and, therefore, was not approved. Subsequent review of the site by the Utah State BLM archeologist determined the site did not require mitigation by avoidance.

Three sites were relocated for cultural reasons: two because man-made aqueducts from a reservoir to a corral cut across the sites, and one because a large water tank was located on the periphery of the site.

Of the sites relocated for geotechnical reasons, all but two were relocated to avoid potentially active washes. One site (HSS 3-10) was located in the middle of a large, active playa (Figure 4-3). Relocation to a nearby area was not possible due to limitations in spacing to other shelters, the extent of the playa, and the QD to the DTN. Relocation of this site to the north of Cluster 3 left HSS 3-13 isolated with a long road segment required to connect it to the rest of the cluster. It was decided to relocate HSS 3-13 near HSS 3-10 at the north of the cluster. HSS 5-8 was located in close proximity to a fault



PINE VALLEY HSS 3-10 (0), VIEW NE TOWARD TPB.

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SHELTER SITE (HSS) LOCATED
ON A PLAYA, PINE VALLEY

8 JUL 81

FIGURE 4-3

scarp defined on the ground by a vegetation lineament and a subtle break in slope. This shelter was relocated approximately 2000 feet south of its original location to avoid several traces of the same fault system.

Most of the sites relocated to avoid potentially active washes were on the east side of the valley where the alluvial fans coming off the mountain fronts are fairly steep. Figure 4-4 is an example of a typical site on the fan surface. Many active washes, 5 to 6 feet (1.5 to 2 m) deep, with cobbles and gravel present in the bottom, intersect the sites. Of the 14 sites relocated for potentially active washes, four were relocated because the wash could affect the shelter door or ramp area, six because of potential problems with the conceptual antenna design, and four where the wash impacted the shelter itself. In all cases, the site could have been constructed as staked, but relocations will reduce the number of drainage structures and grading required for drainage control.

4.3.3 Final Layouts

The final layout for Pine Valley, reflecting site relocations approved by BMO/AFRCE-MX at the 11 February 1981 and 12 March 1981 site review meetings, is shown as Figure 4-5. Many of the relocations are not apparent at this map scale. The only criteria waiver approved was spacing violation to backfill locations.

A number of biological species (or sign of) were identified in the southern part of Pine Valley where Cluster 5 is located.

GENERALIZED SITE ON THE EAST SIDE OF PINE VALLEY (HSS 3-7). FANS ON THIS SIDE OF THE VALLEY WERE TYPIFIED BY DEEP, ACTIVE DRAINAGES WITH COBBLES.

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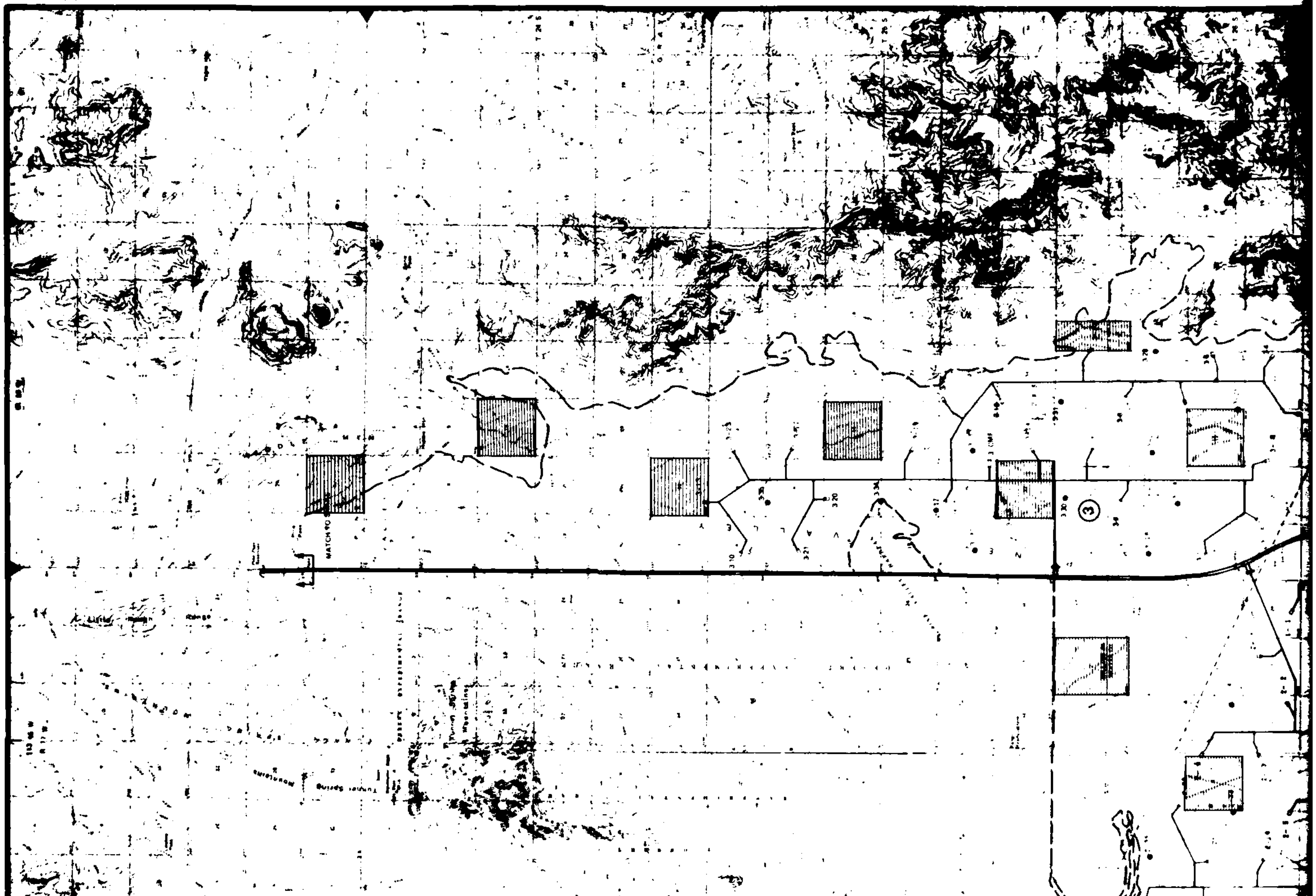
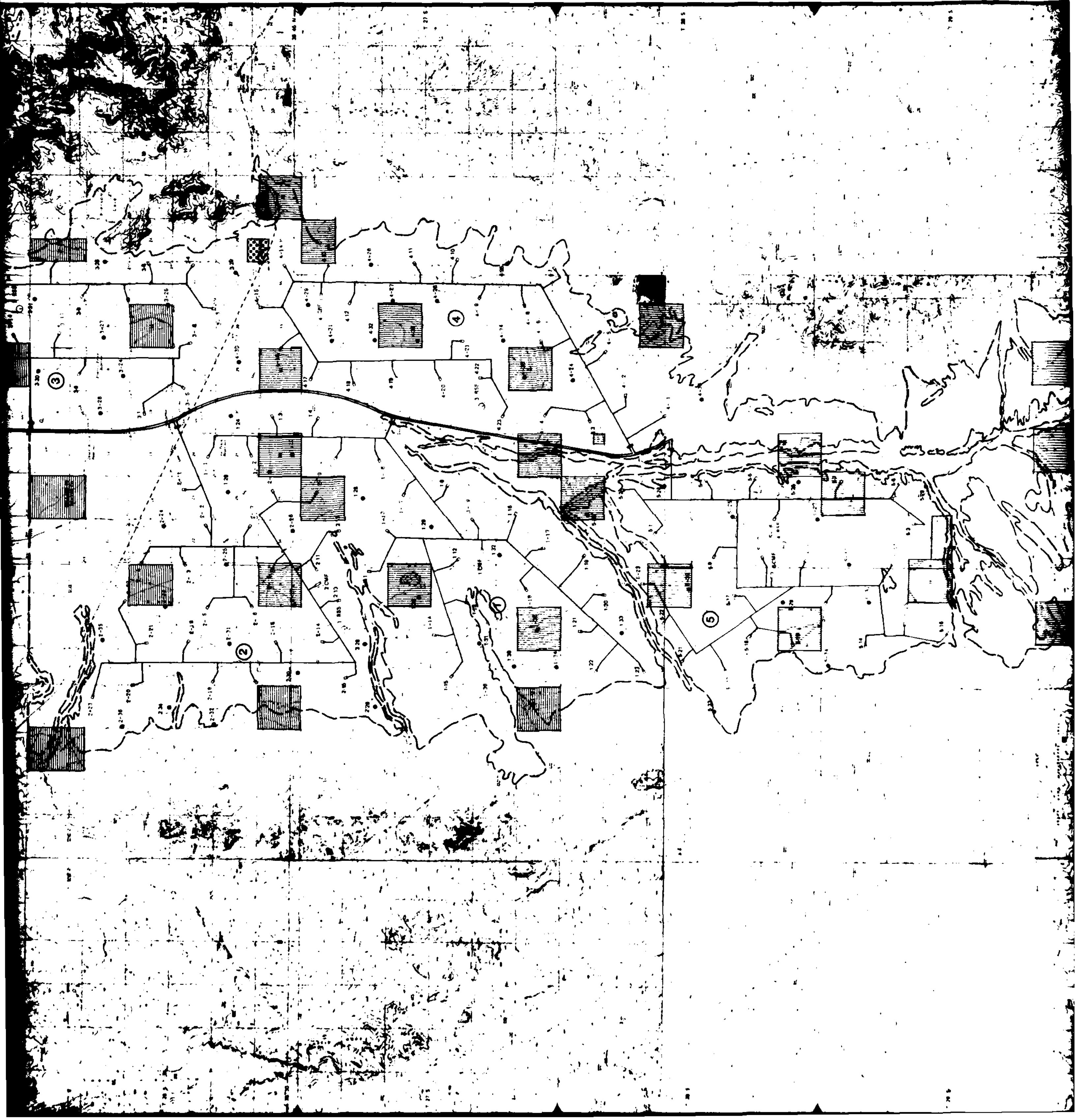
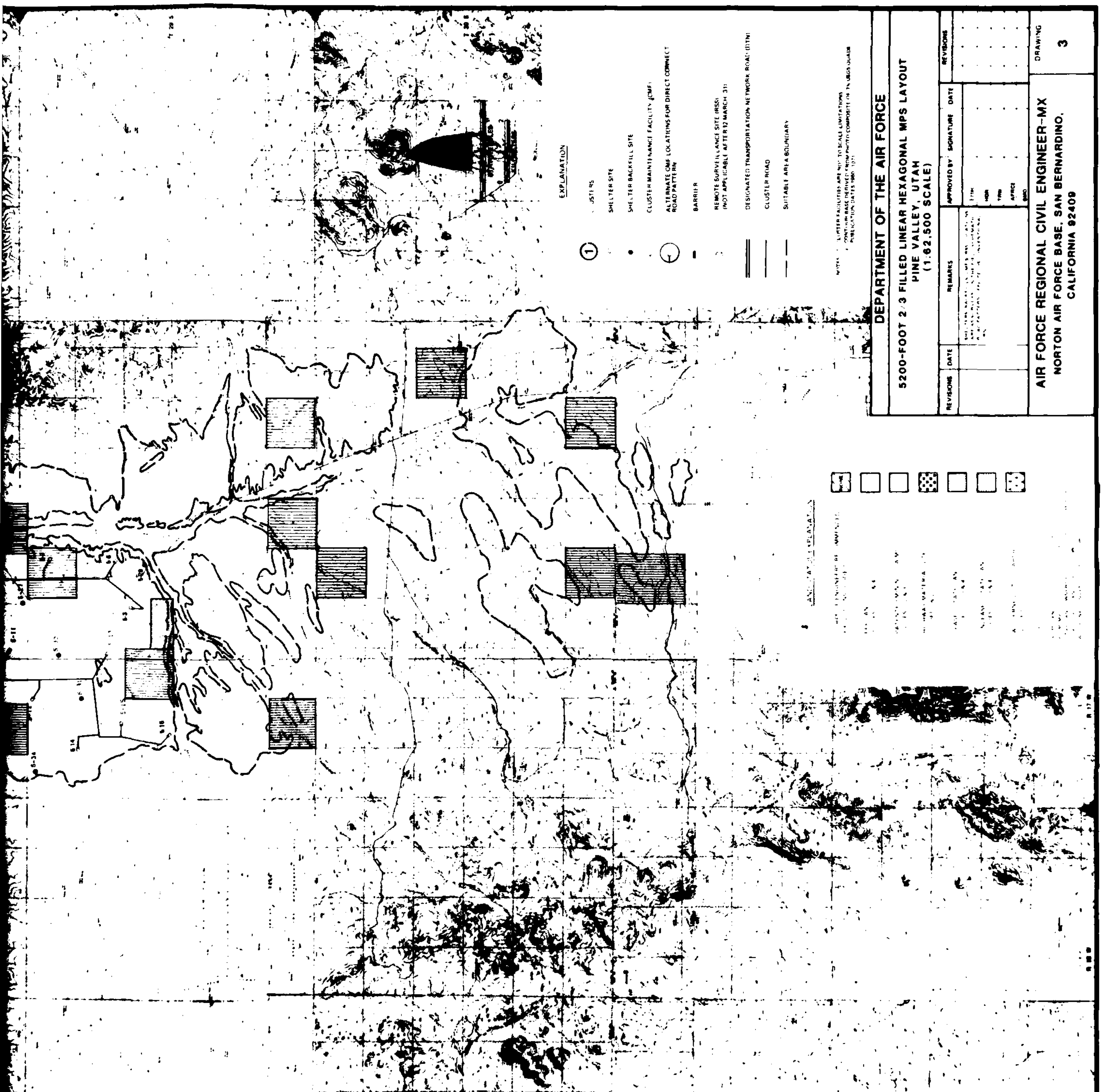
TYPICAL DRAINAGES, EAST SIDE OF PINE VALLEY

8 JUL 81 FIGURE 4-4







PRELIMINARY
SUBJECT TO REVISION

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FINAL LAYOUT FOR IOC FIELD SURVEYS
STRAIGHT LINE ROADS
PINE VALLEY, UTAH

8 JUL 81

FIGURE 4-5

Included were elk, antelope and mule deer migration routes; sage grouse strutting grounds and habitat; raptor nests and hunting grounds; and a variety of sensitive flora. Several mitigation methods, including phased construction, adding water sources for game, increasing game law enforcement, and waiving criteria to allow siting in currently unsuitable areas were recommended as possible mitigation measures.

As presently staked, angle and distance violations exist between several shelters. These are shown on the following table.

Shelter A		Shelter B	Distance (feet)	Angle A to B	Angle B to A
1-22	to	1-21		52.69°	
2-13	to	2-11	4863		
2-15	to	2-14			54.23
3-7	to	3-6	4771		

An incorrect bearing, reversed 180°, was used when Shelter 5-3 was surveyed. The shelter should be rotated 180° around the southernmost monument (the TPB) relocating the rear monument to make the field location consistent with the legal description. The shelter site has already been environmentally surveyed and will not require additional surveys.

A direct-connect road pattern was proposed and adopted between the time of the surveys and the final resitings. Several shelters were relocated based on the direct-connect road concept, but the majority were relocated based on the original straight-line-road-segment concept. Changes in the orientation of several shelters would facilitate connection between shelters if direct-connect roads remain as the baseline. For this road pattern, most CMF locations will change.

Once the road pattern is finalized, the location of the CMFs will be determined, surveyed, and inspected. Legal descriptions of the locations of shelters and CMFs and right-of-way alignments for the roads will be prepared as part of the land withdrawal application.

5.0 WAH WAH VALLEY

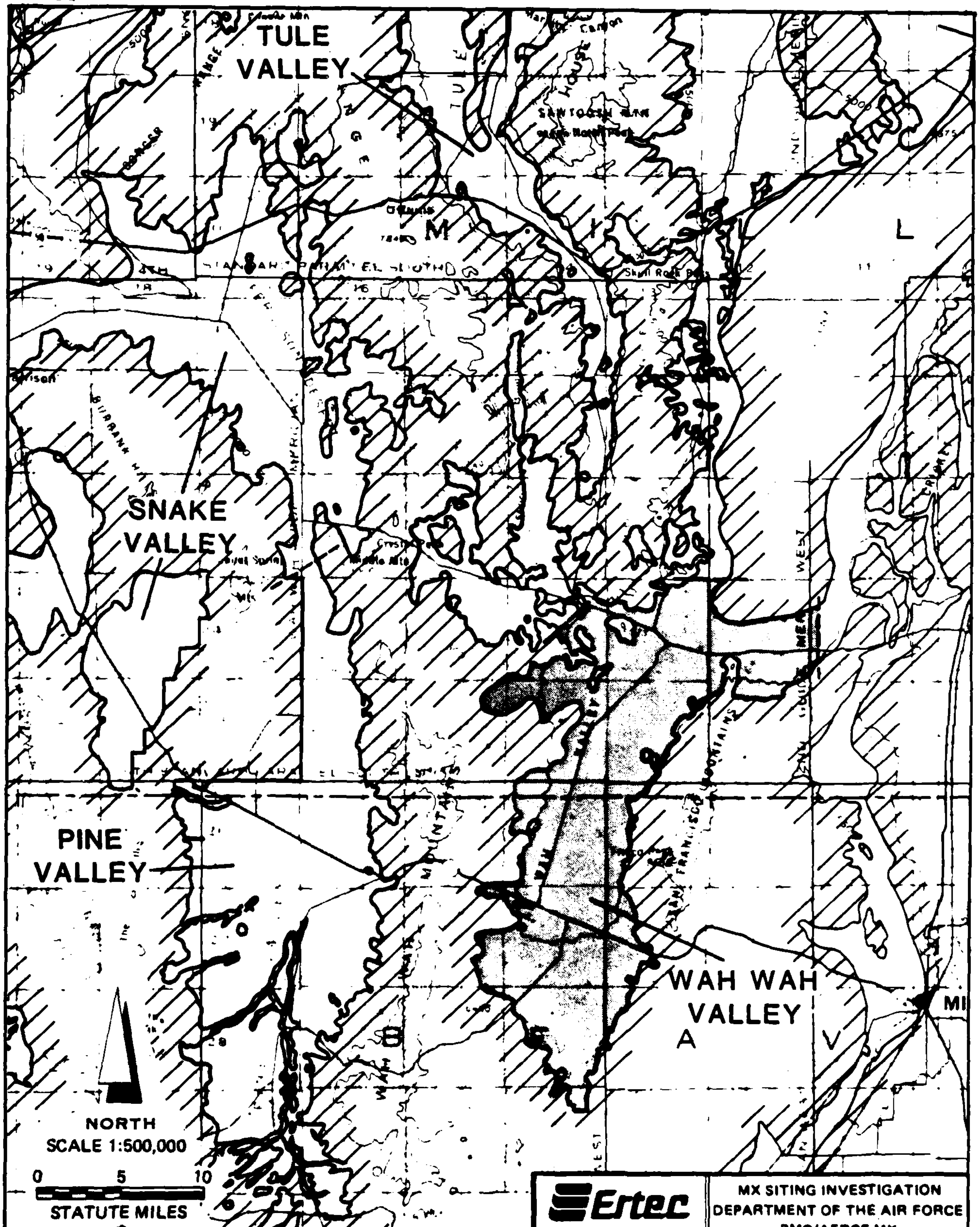
5.1 LOCATION AND CULTURAL CHARACTERISTICS

Wah Wah Valley is located in western Beaver and Millard counties, Utah (Figure 5-1). Milford, the nearest town, lies 25 miles (40 km) to the west. Geographically, the valley is contiguous with Escalante Desert to the south and Whirlwind and Tule valleys to the north. State Highway 21 crosses the south-central portion of the valley. Access to the north of the valley is along graded roads to Wah Wah Well and the Garrison-Black Rock Road and the Tule Valley Road. Many dirt roads and four-wheel-drive trails provide access to the remainder of the valley.

The land is primarily undeveloped desert rangeland which has been improved by construction of scattered corrals, fences, water tanks, stock troughs, and reserviors. Several abandoned mining sites and ranch houses are located within the valley. The land falls mainly under BLM control, with large amounts of leased and unleased state land (sections 2, 16, 32, and 36 of each township, in general) and fee land. Recently, minerals and oil and gas exploration has increased within the valley. Access to the proposed molybdenum mine at Pine Grove is planned to be through Wah Wah Valley. A number of unpatented mining claims have been made in the area around Wah Wah Hardpan.

5.2 GEOTECHNICAL CHARACTERISTICS

Wah Wah Valley is almost totally enclosed by the Wah Wah Mountains to the west and the San Francisco Mountains to the east.



LOCATION MAP
WAH WAH VALLEY, UTAH

8 JUL 81

FIGURE 5-1

These ranges primarily consist of thick sequences of Paleozoic limestone and dolomite, with lesser amounts of Precambrian-Cambrian quartzites and phyllites. Tertiary volcanic rocks, consisting of dacite and pyroclastics with minor basalt, are present in all the mountains bordering the valley (Stephens, 1974; and Hintze, 1963).

The alluvial basin fill of Wah Wah Valley occupies the low portion of a fault block, which resulted from late Tertiary-Quaternary block faulting. The major basin-bounding fault system in Wah Wah Valley is on the east at the base of the San Francisco Mountains. The surface expression of the fault system is a 20-mile- (32-km-) long zone of subparallel scarps in alluvium. Several smaller, localized fault zones occur in other areas of the valley. Lacustrine deposits comprise the majority of the basin-fill units. These were deposited when Pleistocene Lake Bonneville occupied the center of the basin. The highest Lake Bonneville shoreline is well preserved and marks the boundary between the alluvial units at the valley margins and the lacustrine deposits in the center. Minor amounts of fluvial and associated floodplain deposits occur in the small channels that empty onto alluvial fans. The alluvial and fluvial deposits range from sandy gravels to silty sands. The lacustrine deposits are the most variable, consisting of sandy gravels in old lake bars, silty sands and gravelly sands in old lake-bottom sediments, and silts and clays in the active and inactive playas.

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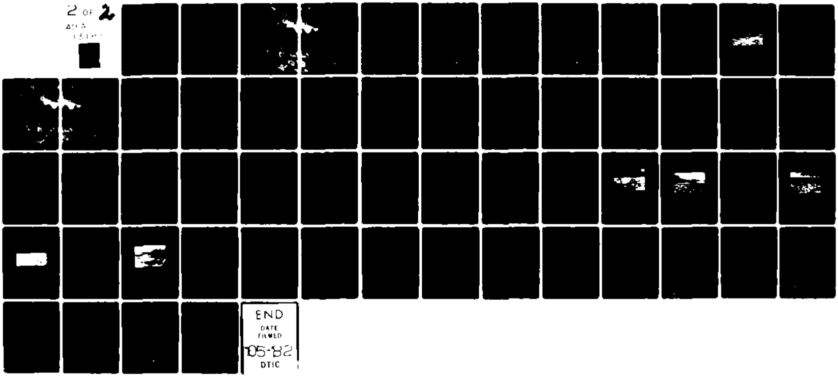

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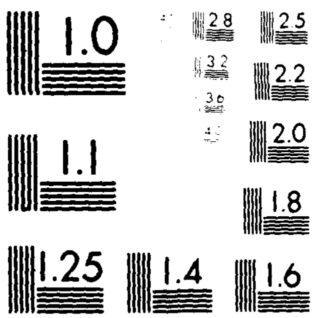


MICROCOPY RESOLUTION TEST CHART

Interpretation of the 50-foot- (15-m-) depth-to-rock contours, used to compile the suitable area boundary, is based on limited point data from borings, seismic refraction surveys, site-specific published data, and depths inferred from geologic and geomorphic relationships. Approximately 15 percent of the basin-fill material in the valley is interpreted to be underlain by rock at a depth of less than 50 feet (15 m).

Within the Wah Wah Valley basin, ground water occurs at depths greater than 200 feet (61 m) near the hardpan and greater than 500 feet (152 m) at the southern end of the valley. Observation wells drilled by Ertec in 1980 indicate water levels at 94 feet (29 m) near Sevier Lake to greater than 1100 feet (335 m) near the center of the valley. A broad alluvial high in the northern part of the valley acts as a drainage divide between Whirlwind and Wah Wah valleys. Surface water is often present in Sevier Lake.

Several areas on the east and northeast sides of the valley were excluded from the suitable area because of slopes exceeding 10 percent. A more intensive description of the geotechnical conditions in Wah Wah Valley is presented in FN-TR-27-WA-I and II.

5.3 LAYOUTS

Wah Wah Valley, in conjunction with Pine Valley, was chosen as the IOC area in Utah due to its location near proposed OB sites in the Beryl-Milford area.

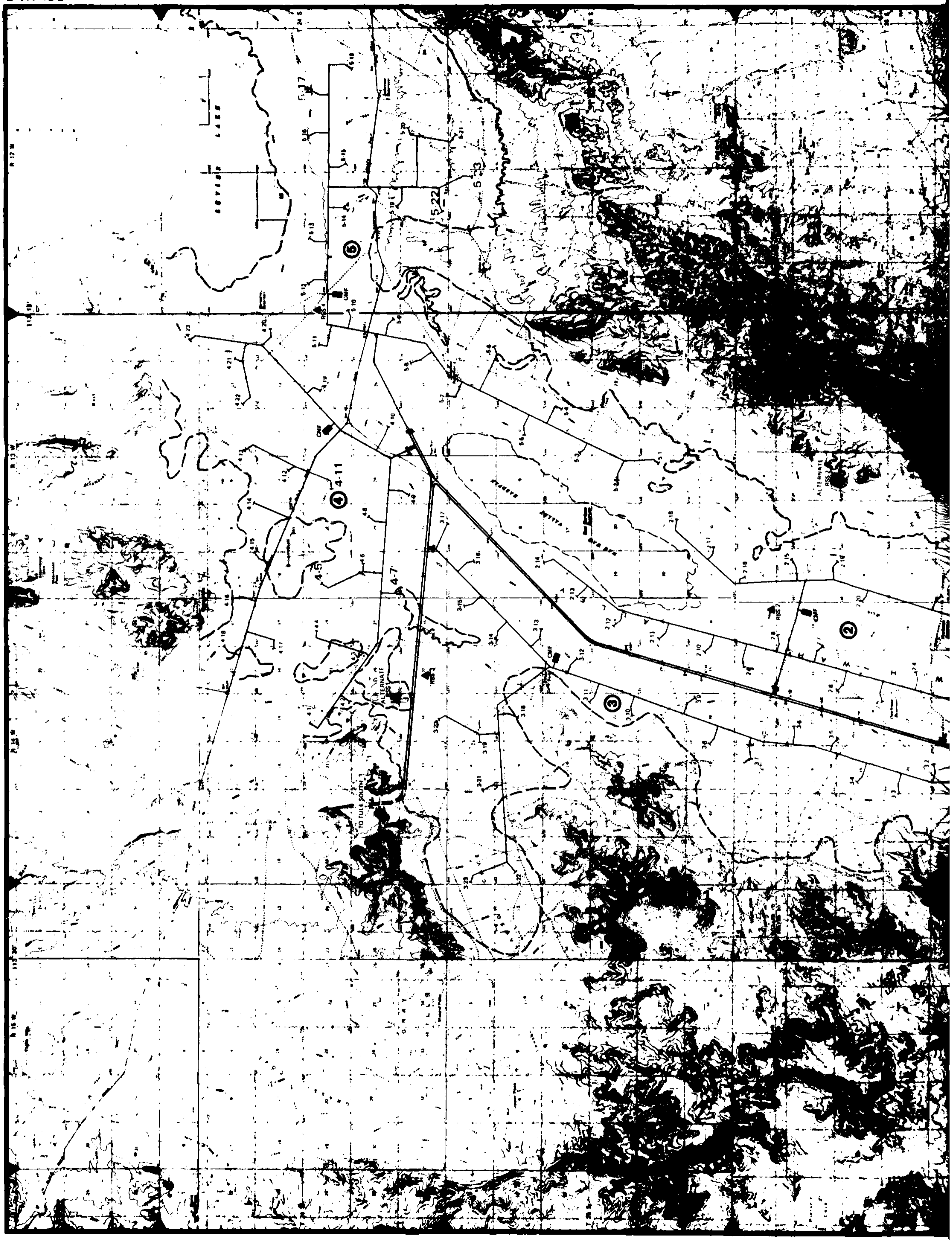
5.3.1 Initial Layouts

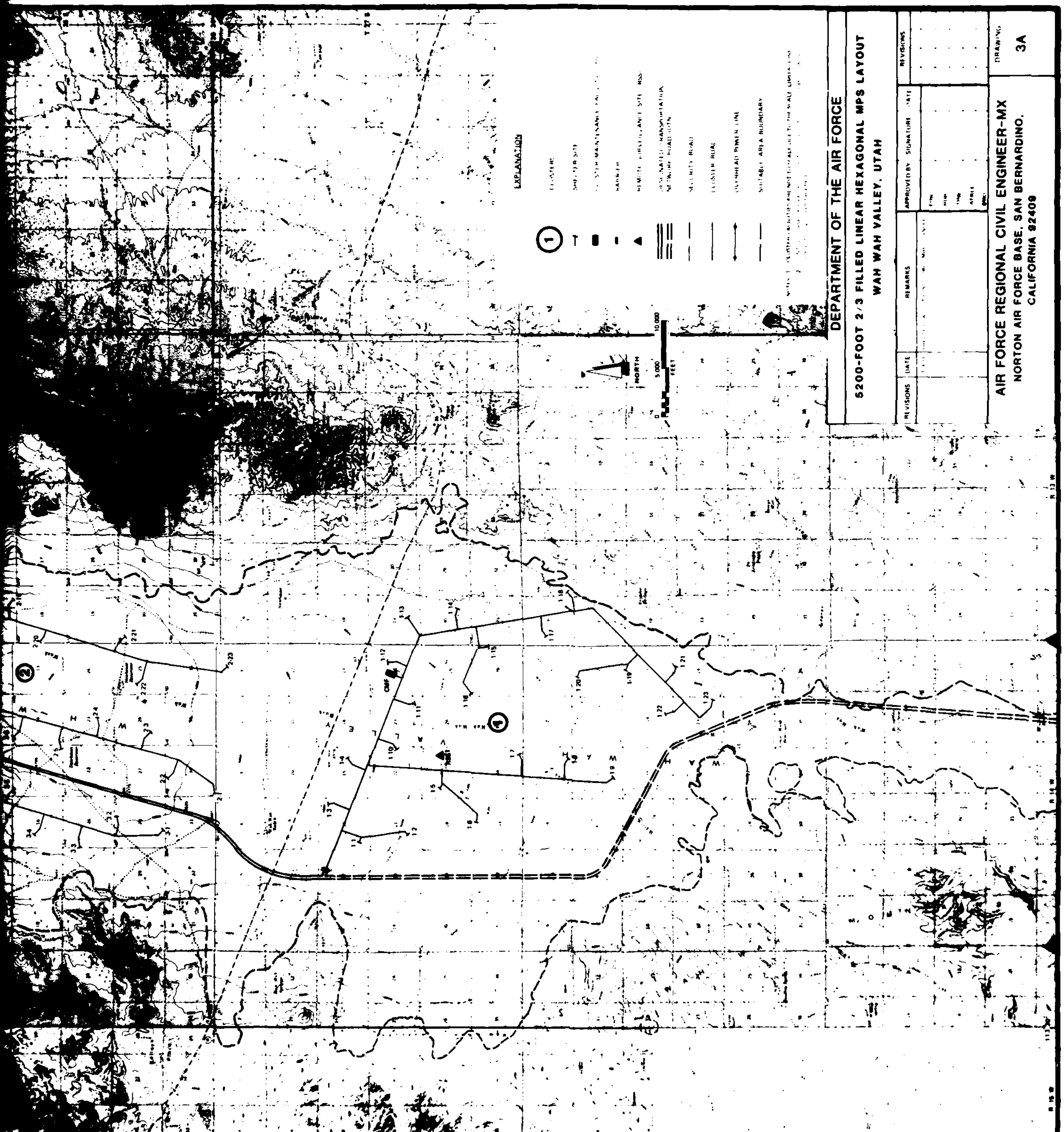
Wah Wah Valley contains 240 mi^2 (622 km^2) of suitable area, into which five clusters, five CMFs, and four RSSs were laid out (Figure 5-2). The northern portion of the valley is contiguous with Whirlwind Valley. The suitable area is contiguous with Escalante Desert to the south but narrows sufficiently to render clustering impractical. Cultural constraints include privately owned land near the Wah Wah Ranch, Utah State Highway 21, and access to a proposed molybdenum mine in the Pine Grove area. Geotechnical constraints include Sevier Lake and Wah Wah Valley Hardpan. The DTN shown on the base map was predicated by an OB in the Beryl-Milford area and the road network based on straight-line segments with cluster roads trending north-south if possible.

After the layout was approved and transferred to the 1:9600 scale topographic maps, the position of each shelter, CMF, and RSS was digitized. Computer checks of distances to and angles between each shelter were made to assure the layout positions complied with the siting requirements.

5.3.2 Results of Field Surveys

Environmental and geotechnical inspections of Wah Wah Valley began on 1 December 1980 and were completed on 30 January 1981. Resitings were completed between 2 and 15 March 1981. As was the case in Pine Valley, weather conditions were variable during the field surveys, with much time lost due to rain, snow, and/or dense fog. Table 5-1 summarizes all approved relocations. Twenty-six sites were relocated, reoriented, or renumbered: two





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INITIAL LAYOUT FOR
IOC FIELD SURVEYS
WAH WAH VALLEY, UTAH

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FIGURE 5-2

SITE	DESCRIPTION OF PROBLEM	*	MITIG
1-21	Small wash with steep sided slopes cuts across site parallel to the centerline. Orientation of shelter 1-21 was in angle violation with shelter 1-23	G	Shelter was moved 410 ft. to the east
1-22	Orientation of shelter 1-22 was in angle violation with shelter 1-23	C	Shelter was reoriented to S 43 W
2-16	Area of active sheet wash and slow drainage. Playa located near true point of beginning (TPB) which could have impacted shelter ramp and road area	G	Shelter was rotated 120° clockwise
2-19	Numerous washes, 10 ft. wide, 3 ft. deep, and 6 ft. wide, 6 ft. deep with active 4 ft. deep incision cut across site	G	Shelter was moved 205 ft. to the nort
2-21	Shelter was located in an area that would collect and pond a large amount of water due to the surrounding geomorphology	G	Shelter was moved approximately 12
3-14	Original orientation of shelter was not compatible with cluster layout after incorporation of changes due to DTN realignment	C	Shelter was reoriented to allow for ea
3-15	Old shelter 3-15 was incorporated into cluster 4 (as 4-1) to facilitate changes in layout due to DTN realignment	C	Shelter was resited to a position appr
3-16	Old shelter 3-16 was incorporated into cluster 4 (as 4-2) to facilitate changes in layout due to DTN realignment	C	Shelter was resited to a position appr
3-17	Old shelter 3-17 was incorporated into cluster 4 (as 4-3) to facilitate changes in layout due to DTN realignment	C	Shelter was resited to a position appr
3-22	Old orientation of shelter 3-22 violated angle criteria to new shelter 3-17	C	Shelter was reoriented to allow for ea
3-23	Old location of shelter 3-23 was reassigned to a backfill position to facilitate changes in layout due to DTN realignment	C	Shelter was relocated to a position a west northwest of 3-22
4-1	Old location of shelter 4-1 violated the standoff distance with the new DTN alignment	C	Shelter 3-15 was renumbered 4-1 and
4-2	Old location of shelter 4-2 violated the standoff distance with the new DTN alignment	C	Shelter 3-16 was renumbered 4-2 and
4-3	Old location of shelter 4-3 violated the standoff distance with the new DTN alignment	C	Shelter 3-17 was renumbered 4-3 and
4-14	Bedrock outcrop was located near shelter; probable shallow rock (less than 25 ft.) underlies entire site	G	Shelter was moved approximately 11
4-17	Shelter located near the edge of a steep slope at edge of a major drainage area	G	Shelter was moved 250 ft. to the sou

EXPLANATION

* A Archeological
G Geotechnical
C Criteria

** Direction of movement relative to shelter site and does not indicate actual direction

Determination of changes of road leng
which was in effect during IOC Field Su

Net road length changes are generally l

All shelter relocations are relative to th

MITIGATION	IMPACT **
ved 410 ft. to the east and reoriented to N 53 E	1. Shelter road length increased slightly 2. Shelter reorientation is dependent on a " direct connect" road network
riented to S 43 W	1. Shelter reorientation is dependent on a "direct connect" road network
ated 120°clockwise	1. Road connection is dependent on a "direct connect" road network
ved 205 ft. to the northwest	1. Shelter road length decreased slightly
ved approximately 1250 ft. to the north northeast	1. Trunk road length decreased
riented to allow for easier connection with the roads network	1. Realignment of the DTN after field surveys were completed required resurveying and reinspecting portions of the shelter site
ited to a position approximately 1 mi. west of shelter 3-7	1. Realignment of the DTN after field surveys were completed required resurveying and reinspecting a new shelter site
ited to a position approximately 1 mi. southwest of shelter 3-1	1. Realignment of the DTN after field surveys were completed required resurveying and reinspecting a new shelter site
ited to a position approximately 1 mi. west of shelter 3-21	1. Realignment of the DTN after field surveys were completed required resurveying and reinspecting a new shelter site
riented to allow for easier connection with the roads network	1. Realignment of the DTN after field surveys were completed required resurveying and reinspecting portions of the shelter site
located to a position approximately 1 mi. to the t of 3-22	1. Realignment of the DTN after field surveys were completed required resurveying and reinspecting a new shelter site
s renumbered 4-1 and included as part of cluster 4	1. Survey monuments along the centerline of the shelter were renumbered to reflect change. Ultimately, all references to shelter number will have to be corrected to show this change
s renumbered 4-2 and included as part of cluster 4	1. Survey monuments along the centerline of the shelter were renumbered to reflect change. Ultimately, all references to shelter number will have to be corrected to show this change
s renumbered 4-3 and included as part of cluster 4	1. Survey monuments along the centerline of the shelter were renumbered to reflect change. Ultimately, all references to shelter number will have to be corrected to show this change
oved approximately 1100 ft. to the north, reoriented to N 20 E	1. Shelter road length decreased slightly
oved 250 ft. to the south	

changes of road lengths is based on original straight line road layout pattern, t during IOC Field Survey program.

hanges are generally less than 500 ft., unless otherwise specified.

tions are relative to the True Point of Beginning (TPB) of the surveyed site.

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SUMMARY OF SHELTER RELOCATIONS,
WAH WAH VALLEY, UTAH
PAGE 1 OF 2

8 JUL 81 TABLE 5-1

' 2

SITE	DESCRIPTION OF PROBLEM	*	MITI
5-5	Large, low density lithic scatter	A	Shelter was moved 265 ft. to the
5-7	Large, thin lithic scatter	A	Shelter was moved 400 ft. to the
5-8	Site was located on an old bar and lake bed formed by Pleistocene Lake Bonneville. Slope of bar and site geomorphology would have caused flooding/construction problems to the road and ramp	G	Shelter was moved 200 ft. to the
5-13	Shelter was located on the edge of an erosional shoreline formed by Pleistocene Lake Bonneville	G	Shelter was moved 205 ft. to the
5-14	Large, wide wash, 10 ft. - 15 ft. deep, with 5 ft. - 10 ft. wide active portion, with incisions of up to 6 ft. deep located between the center and rear monument	G	Shelter was moved 205 ft. to the
5-18	Site was located within a dunal area, characterized by highly dissected sand dunes underlain by clayey lake beds. Irregular relief up to 10 ft	G	Shelter was moved 2600 ft. to th
5-19	Large, wide, 5 ft. deep wash located near rear monument	G	Shelter was moved 250 ft. to the
5-20	Shelter located on the edge of a 10 ft. - 12 ft. high, steep shoreline formed by Pleistocene Lake Bonneville	G	Shelter was moved approximat reoriented to S 42 E
5-22	4 ft. deep active wash runs along the centerline of the shelter site	G	Shelter was moved 150 ft. to the
5-23	Two 5 ft. - 10 ft. wide, 5 ft. deep washes cut through rear fenced area, which could impact the antenna in its present configuration	G	Shelter was moved 125 ft. to the

EXPLANATION

* A Archeological
G Geotechnical
C Criteria

** Direction of movement relative to shelter site and does not indicate actual direction

Determination of changes of road le which was in effect during IOC Field

Net road length changes are generall

All shelter relocations are relative to

MITIGATION	IMPACT * *
moved 265 ft. to the north	1. Truck road length decreased slightly
moved 400 ft. to the west	1. Truck road length increased slightly
moved 200 ft. to the south	1. Shelter road length decreased slightly
moved 205 ft. to the south	1. Shelter road length decreased slightly
moved 205 ft. to the north	1. Shelter road length decreased slightly
moved 2600 ft. to the southeast, *reoriented* to S 30 E	1. Road length will be shorter with "direct connect" concept
moved 250 ft. to the north northeast	
moved approximately 900 ft. to the southeast, o S 42 E	1. Shelter road length increased
moved l50 ft. to the southeast	
moved l25 ft. to the north	1. Shelter road length decreased slightly

changes of road lengths is based on original straight line road layout pattern, st during IOC Field Survey program.

hanges are generally less than 500 ft., unless otherwise specified.

tions are relative to the True Point of Beginning (TPB) of the surveyed site.

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SUMMARY OF SHELTER RELOCATIONS,
WAH WAH VALLEY, UTAH
PAGE 2 OF 2

8 JUL 81 TABLE 5-1

for archeological reasons; 14 for geotechnical considerations; and 10 for criteria, most of which resulted from major rerouting of the DTN after the layouts and field surveys were completed. Nineteen sites had to be relocated; the distances are summarized in the following table:

NUMBER OF SITES	DISTANCE RELOCATED, Feet (m)
9	< 250 (<76)
2	250 - 500 (76-152)
1	500 - 1000 (152-305)
2	1000 - 1500 (305-451)
4	> 1500 (>457)

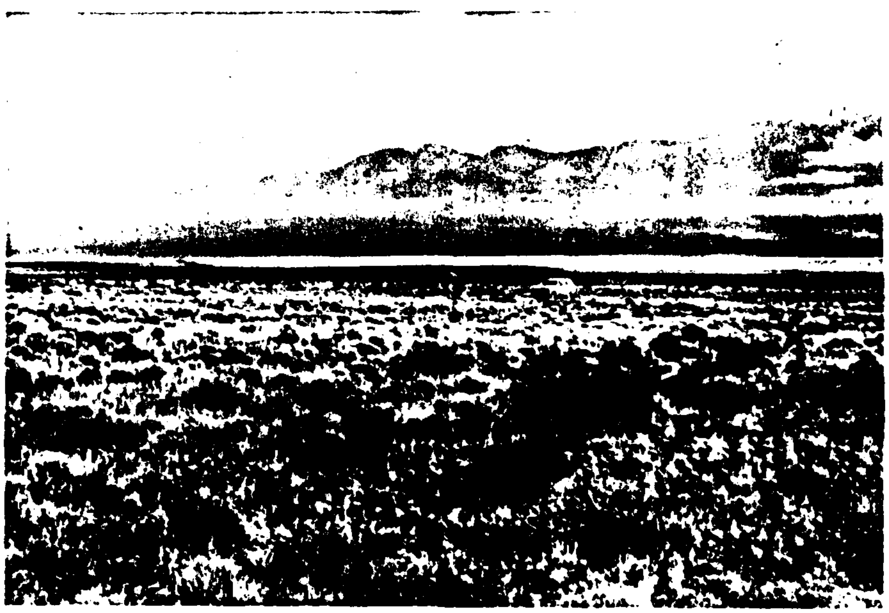
Because major changes were made in the DTN route, four of the sites were relocated about a mile. Four sites were reoriented and three sites in Cluster 3 were renumbered and included in Cluster 4.

Biological and cultural findings are discussed in Volumes II (Part II) and III (Part II) of this report. No sites were relocated for biological resources. Individuals of a sensitive cactus species were found on seven sites. Antelope signs were found on 21 sites, but no migrating pattern or habitat could be ascertained from the site-specific data. Three sites and CMF 3 were recommended for relocation based on archeological findings by Ertec Northwest. Mitigation by avoidance was possible for HSSs 5-5 and 5-7. It was not possible to relocate HSS 4-8 near its original location due to angle and spacing limitations. The closest suitable site was to the east of Tule Valley Road, approximately 5 miles (8 km) northwest of the original location. Relocation of HSS 4-8 was not approved by BMO/AFRCE-MX because a

substantial addition of road length would be necessary to link the site to the cluster. Subsequent review of the original site by the Utah State BLM archeologist indicated mitigation by avoidance was not required at HSS 4-8. CMF 3 was not relocated at the time of the field surveys because changes in the road pattern, discussed below, will require changes to all the CMFs.

One site (HSS 4-14) was located near a limestone ridge at the edge of a small basin; there was a high probability that rock at less than 25 feet (8 m) underlies the entire site. The site was moved closer toward the center of the basin. The remaining sites were moved because of potentially active washes. At four sites, the wash could affect the front door or ramp of the shelter; the shelter itself could be impacted at seven sites, and the antenna, as presently conceptualized, could be affected at two sites.

Ertec Western, Inc. recommended relocation of HSS 3-3, located on a small, steep, active fan on the west side of the valley (Figure 5-3). The fan surface was characterized by numerous distributary channels, 3- to 4-foot (0.9- to 1.2-m) boulders on the surface, and smaller cobbles in the channel bottoms. Relocation of this site to the closest suitable site would have required an additional 1 mile (1.6 km) of cluster road, which was considered more costly than remedial construction measures; the relocation was not approved by BMO/AFRCE. All sites moved for geotechnical reasons could have been constructed as originally staked, but relocations will reduce the number of drainage structures and grading required for drainage control.



ACTIVE FANS ON THE WEST SIDE OF WAH WAH VALLEY (HSS 3-3, VIEW E TOWARD TPB). FAN SURFACE WAS CHARACTERIZED BY LARGE BOULDERS (2 FT. - 3 FT. IN DIAMETER).

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TYPICAL FAN SURFACES, WEST SIDE OF WAH WAH VALLEY

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FIGURE 5-3

5.3.3 Final Layout

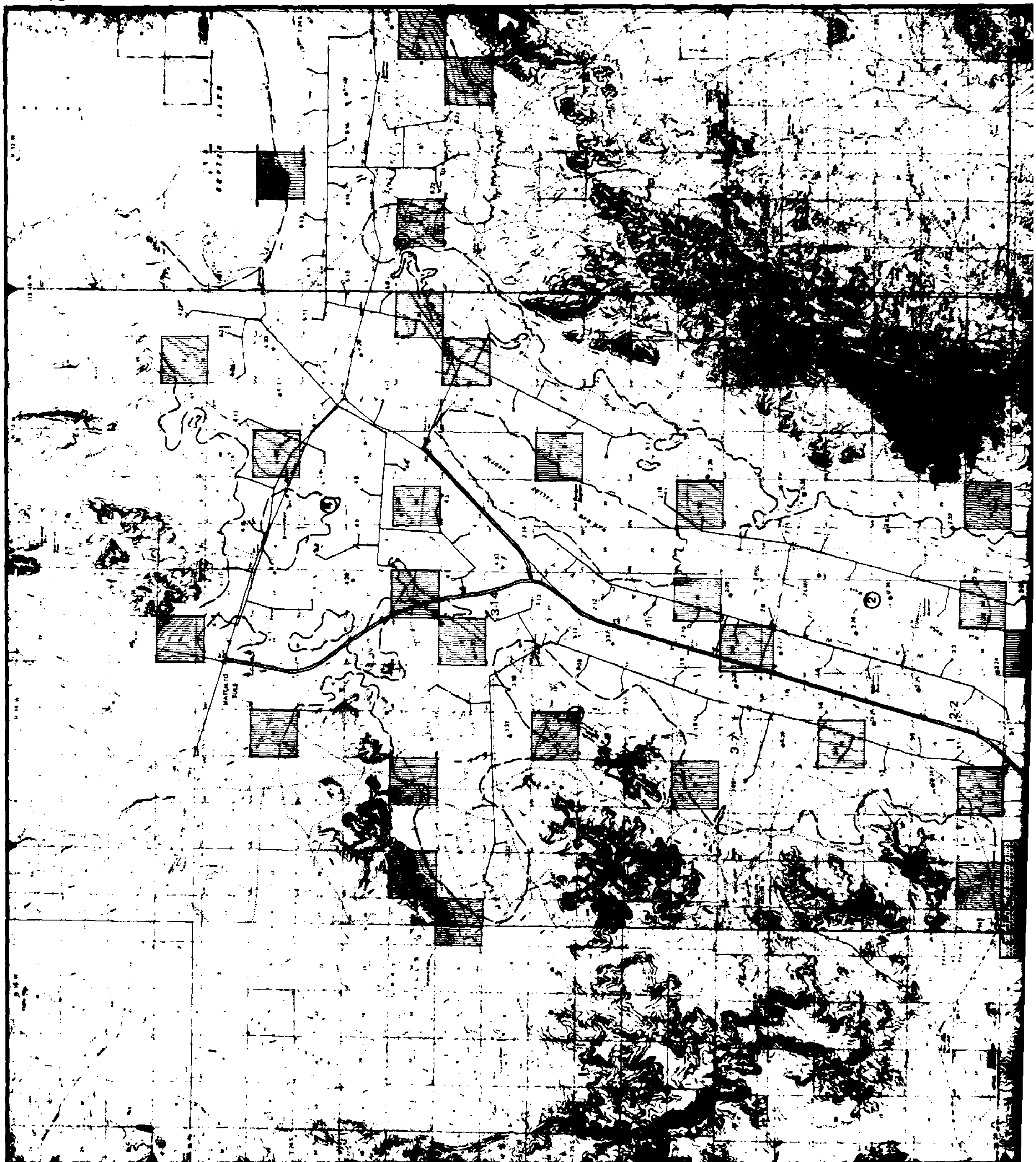
Figure 5-4 presents the final layout for Wah Wah Valley. Many relocations are not apparent at this scale. The map reflects site relocations approved by BMO/AFRCE-MX at the 11 February 1981 and 12 March 1981 site review meetings. Waiver of spacing violations to backfill locations apparent on Figure 5-4 were approved at this time.

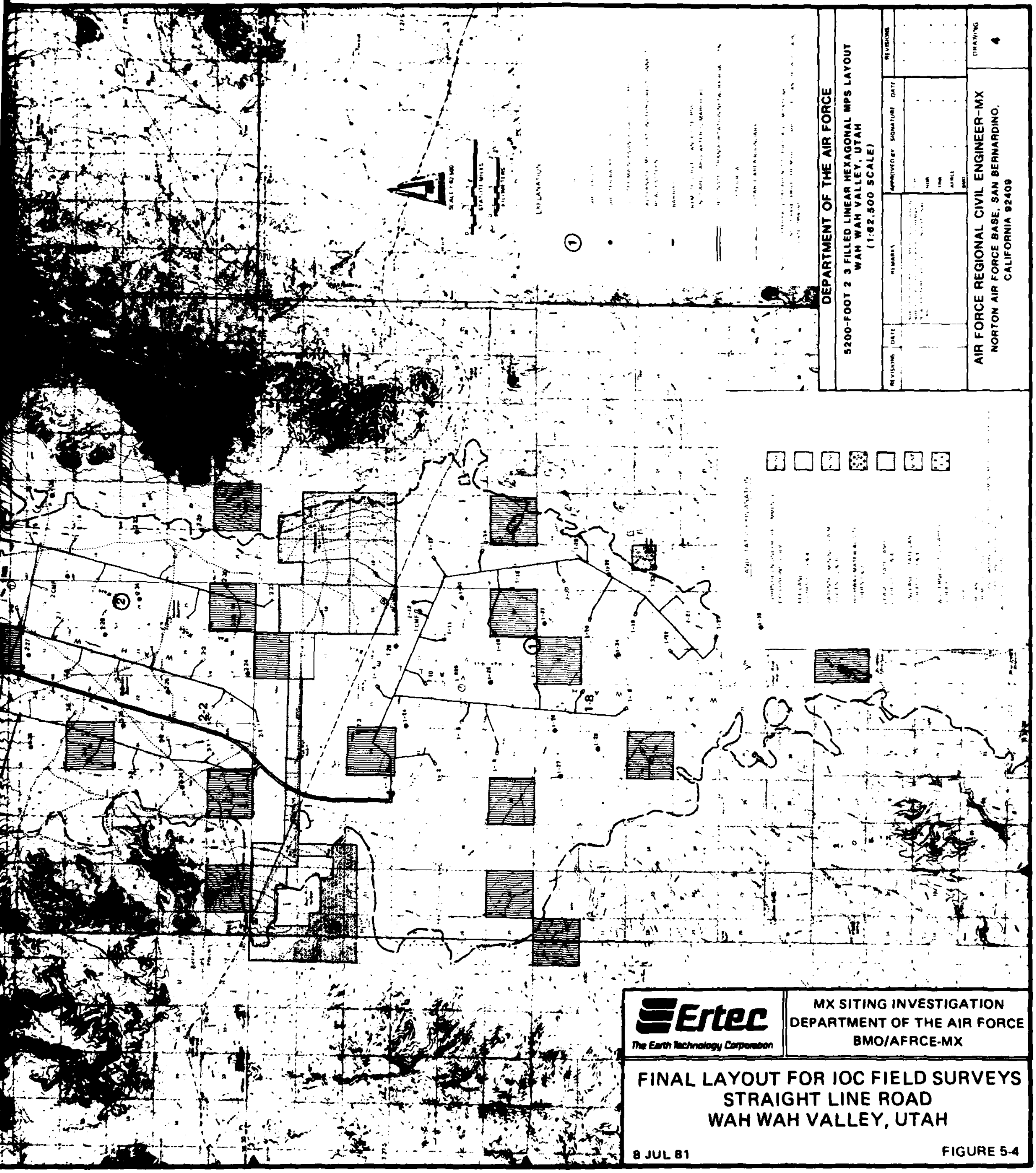
A major change in the DTN route in the northeast side of the valley was approved by BMO/AFRCE-MX after the completion of initial layouts and the field surveys. A total of nine shelters were affected by this change; four shelters were relocated, three shelters were renumbered and included in a different cluster, and two were reoriented to facilitate road connections.

Shelters 3-23 (relocated), 1-21 (reoriented), and 1-22 (reoriented) were not environmentally inspected because the changes to the layout were approved and remonumented after the environmental surveys were completed. The bearing was changed on Shelter 3-23 after it was cadastrally surveyed. The TPB and rear monuments of the shelter site will have to be reversed in the field to conform with its legal description.

As presently staked, angle and distance violations exist between Shelters 5-23 and 5-21 and 5-23 and 5-22 as shown on the following table:

SHELTER A		SHELTER B	DISTANCE (feet)	ANGLE A TO B	ANGLE B TO A
5-23	to	5-21	4901		54.50°
5-23	to	5-22	4952		





PRELIMINARY
SUBJECT TO REVISION

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BMO/AFRCE-MX

FINAL LAYOUT FOR IOC FIELD SURVEYS
STRAIGHT LINE ROAD
WAH WAH VALLEY, UTAH

8 JUL 81

FIGURE 5-4

An incorrect bearing, reversed 180°, was given to the land surveyors at the time of the resiting of Shelter 5-23. The shelter should be rotated 180° around the southwesternmost monument (the TPB), relocating the rear monument, to make the field location consistent with the legal description. The shelter site has already been environmentally surveyed and will not require additional surveys.

A direct-connect road pattern was proposed and adopted after the initial phase of the field surveys was complete. Changes due to the DTN rerouting were made with direct-connect as the baseline road pattern. All other relocations were based on the original road network design. Changes in the orientation of several shelters would facilitate road connection if direct-connect remains as the baseline. For this road pattern, most CMF locations will change.

Once the road pattern is finalized, the location of the CMFs determined, surveyed, and inspected, legal descriptions of the locations of shelters and CMFs and right-of-way alignments for the roads will be prepared as part of the land withdrawal application.

6.0 EVALUATION OF PROCEDURES

6.1 OVERVIEW

The field surveys in the IOC valleys have provided a test for a number of processes which have been used in preparing conceptual shelter layouts for the MX weapons system. It has provided a test for siting criteria, geotechnical verification of suitable area, adequacy of map scales, layout procedures, and field survey procedures. At the same time, it has provided detailed site specific information about the geotechnical conditions, biological resources, and cultural resources in the three IOC valleys. The lessons learned from the study will be applied to a siting methodology which is in a development stage.

In evaluating the IOC program, it is necessary to look at the specific procedures used in the study as well as the overall methodology. In either case, it is necessary to identify what changes should be made to improve the procedures and what additional tasks should be carried out to improve the methodology.

In general, the studies were very successful in that:

- The siting criteria is reasonable and does work in the deployment valleys.
- The verification process to define suitable area boundaries appears to be successful since only two of 493 sites had to be relocated because of violation of criteria.
- A map scale of 1:9600 is adequate for locating shelter sites in the field. Survey coordinates can be determined with sufficient accuracy.
- The shelter layout procedures and field survey procedures worked reasonably well and only minor modifications are recommended for future studies.

- The studies did assist in determining what additional tasks and activities should be incorporated in future programs to improve the layout methodology.

A more detailed evaluation of the procedures and overall process are presented in the following sections.

6.2 EVALUATION OF PROCEDURES

6.2.1 Layouts

The process of determining siteable area and preparing conceptual layouts proved to be very successful. The primary problem related to the details of the process and the mechanics of dealing with large amounts of data. The areas of concern were:

- Accuracy of base maps as a result of having to splice together various scales of existing topographic base maps to produce a composite map of each valley;
- Working with a number of overlays and the registration problems inherent in such a process;
- Inaccuracy in the data being used or discrepancies of data from two different sources; and
- Errors inherent in transferring data from one map scale to another.

By incorporating adequate quality assurance procedures, most of these problems are not serious at a scale of 1:62,500 (1 inch ≈ 1 mile) because of the limitations of the scale itself. At this scale, a 1/16-inch thick line represents a horizontal distance of 326 feet (99.4 m). Plotting data to an accuracy of 200 feet (61 m) or 300 feet (92 m) is about the limit. It is for this reason that a scale of 1:9600 is needed for performing detailed studies.

The second problem regarding the layout process was the lack of complete cultural and environmental data prior to starting the IOC methodology program. This problem was known at the time the program was started, however, tight time schedules did not allow the luxury of waiting until all data had been collected. The study did reveal the importance of having as much data as possible before starting layouts since the siting criteria limits flexibility of changes. If several shelters have to be relocated after layouts have been completed, there can be a ripple effect since other shelters have to be relocated to satisfy the siting criteria. Having to move five to 10 shelters could cause the need for an entire new layout.

6.2.2 Transfer to 1:9600 Scale Maps

Transfer of shelter sites from the 1:62,500 to the 1:9600 scale maps was an essential process for accurately determining coordinates for field locating the shelter sites. It also provides the opportunity of adjusting the layouts for terrain features which could not be identified on the smaller scale maps. The 10-foot (3-m) contours at the 1:9600 scale did identify 5- to 10-foot-(1.5- to 3-m) deep drainages, and it was possible to relocate shelters to avoid such features. The map scale was not adequate to identify smaller drainages as evidenced by the fact that 73 percent of the sites that were relocated were because of washes and drainages that could affect the ramp into the shelter, the shelter itself, or the proposed antenna area behind the shelter.

As the layout process continues, it is expected that the 1:9600 maps will have more use. As more detailed cultural, environmental, and land status data are obtained, it can be transferred to these maps or to overlays at the same scale so that site-specific concerns can be addressed. Cultural information such as fences, pipelines, underground transmission lines, power corridors, and reservoirs can be accurately located at this scale and can be considered in the layout process. These features cannot be accurately evaluated at the 1-inch to 1-mile scale.

6.2.3 Digitizing

Digitizing of shelter sites on the 1:9600 scale maps to determine survey coordinates proved to be successful. The computer programs used to check spacing and orientation violations indicated that only rarely were there violations. An analysis of the process suggests that digitized points on the 1:9600 scale maps are generally reproducible to within 50 feet (15 m). For shelter relocations of this same order of magnitude, using the digitizer can result in errors in determining coordinates. The better approach is to mathematically derive the new coordinates. The digitizer can be used for relocating shelter if the distance is 100 feet (30 m) or more.

It was found from the detailed surveys of Cluster 2 roads in Dry Lake Valley that road PIs are more easily derived by mathematical calculations. The $\pm$ 50 feet (15 m) error that occurs with the digitizer can cause errors in straight-line road intercepts with the shelter centerline and in the perpendicularity of the

shelter road junction with the trunk road. If the TPB of the shelter site and the point where the shelter road leaves the trunk road are digitized and the road layout criteria known, then an inverse calculation between these points can be made to determine the PIs.

6.2.4 Surveying

An evaluation of field surveying procedures used is beyond the scope of this report. All surveying was completed according to professionally recognized standards. This evaluation deals not so much with the survey effort, but with coordination between the program manager, survey crews, and in-house support personnel.

Comparison of the survey effort in Dry Lake Valley with that for Pine and Wah Wah valleys emphasized the importance of having managers/supervisors for the survey crews and the IOC program in daily contact. Problems, misconceptions, or unclear data and instructions could immediately be clarified. Changes to the layout or the preferred sequence of clusters to be surveyed could be communicated and implemented rapidly. It was also important to designate one individual through whom all contacts with the survey crews are made to avoid confusion.

Adequate lead time prior to the beginning of the environmental surveys is required so survey crews can recover existing controls and establish additional control nets over the valley. Generally, two survey crews can locate and monument four to six shelters per day, but survey conditions, length of traverses

between controls, and terrain can lower that average. The surveyors and the environmental crews need to be monitored and coordinated so one group is not impeded by the other's progress.

No surveying of shelter sites, CMFs, or RSSs should begin until a final version of the layout is approved and all survey coordinates are ready to be released to the survey crews. The valley can be systematically and more effectively covered with a control network if all site locations are known prior to commencement of the field surveys.

All control points and site monuments should be required to be doubly determined (i.e., another control point should be used to check location and azimuth). In Dry Lake Valley, auxiliary control points set near the TPB of the sites facilitated locating the site by the environmental and geotechnical crews and also made it much quicker and easier to move a site, if necessary. Setting up the auxiliary controls requires more lead time prior to monumenting sites but shortens the time needed to adjust cumulated survey errors and set in sites. The cadastral surveying in Pine and Wah Wah valleys was performed by a different contractor. Auxiliary controls were not used and not having them did increase the time required to set the sites, to locate sites after they were surveyed, and to relocate sites.

Permanent markers (metal fence posts or other durable material) are needed near each TPB if sites are to be easily located for follow-on studies. During the field surveying, wooden laths

were used to mark the location of the TPB. Cattle tended to knock over the laths and made it extremely difficult to locate the site after several days. A permanent marker, visible from a distance, will make it easier to find a site and probably lessen the amount of off-road driving that can occur while trying to find the site. Project meetings with all the subcontractors (survey and environmental crews) and other project personnel should be held once a week to inform everyone of status, changes, and problems associated with the field surveys.

6.2.5 Environmental Surveys

A detailed analysis of the environmental (biological and cultural resources) program is presented in Volumes II and III of this report.

Generally, the procedures developed by Ertec Northwest, AFRCE-MX, state agencies, and other consultants were adequate to evaluate the valley resources and provided a basis for recommending site relocations. The manner in which the field surveys were carried out and the logistics involved at each site worked well.

The procedures for the field surveys of IOC valleys were adequate for an overview, but additional work, including systematic collection and subsurface testing for cultural resources, was recommended by BLM personnel and Ertec Northwest for future studies in other valleys. The sample units (i.e., shelter sites) were determined by the project needs rather than cultural resources design. A better research design, which could include

random locations and larger sample units, and a valley-wide survey could result in more useful and valid data. Avoidance is not always the best, or most feasible, mitigation method. Other mitigation methods, such as collection and/or excavation, can be included in research plans for future work. The significance of sites can be evaluated on a valley-wide rather than site-specific basis. Mitigation criteria should be flexible enough to cover unusual or unexpected situations.

The dynamic nature of biological resources presented difficulty when trying to establish a list of criteria on which to base recommended relocations. Although a case-by-case decision process is necessary, a panel of experts should be assembled to issue guidelines prior to, and act as consultants during, the field work.

6.2.6 Geotechnical Inspections

The field surveys did indicate that geotechnical inspections should be made at each site. Examinations of color aerial photographs and topographic maps were made to flag potential problem sites. Many of these sites were geotechnically suitable when the site was inspected. Most of the resitings were due to the presence of drainages which could not be accurately determined because of the scale of the maps and the photos. The primary problem is that it is not possible to accurately locate small drainages on the 1:9600 scale maps when the contour interval is 10 feet (3 m) (see Figure A3-2 for an example). For example, the horizontal distance between contours for a three percent slope is 333 feet (102 m). In a typical case, only

two contours will cross a 2-1/2-acre parcel. If topographic maps with 1- or 2-foot (0.3- to 0.6-m) contour intervals were available, then it would be possible to accurately identify the drainages having a depth of about 6 feet (1.8 m) or less (see Figure A3-1 for an example). Such maps would be extremely costly and are not warranted until the design stage of the program.

6.2.7 Resitings

The most important lesson learned during the resiting process is that the resitings should be done after the valley is completely surveyed. This process saves time and helps in the decision making process. Waiting until the valley is completed also alleviates inadvertently complicating the resiting effort, which could occur if it is not known from the start that a neighboring shelter has to be relocated.

The resiting process proceeded smoothly if relocations were small enough to use existing monuments as reference points from which the environmental crews could work. Reinspecting and resurveying shelter sites could proceed independently of each other as long as coordination of effort was maintained.

One person is needed to act as coordinator for all resitings to ensure conformity, to follow through on field work, and to avoid duplication of effort and inadvertent criteria violations that could result if two people are moving different shelters simultaneously.

Coordinates for shelters resited to a proximal location can be generated mathematically if distances and direction are known.

The time delay involved and the inability to accurately reconstruct the same points when using the digitizer created some problems and inconsistencies. A programmable calculator can be used to perform internal angle and spacing criteria checks as well as generate new survey coordinates if resitings have to be coordinated from a field office. Generating shelter coordinates and performing internal checks must be done with a digitizer and computer if the shelter is moved a great distance from the original site.

If possible, all relocations should be decided upon, new coordinates released to the surveyors, and verbal and graphic descriptions of the relocations issued to the environmental crews at the same time to avoid confusion.

6.3 EVALUATION OF METHODOLOGY

The field surveys in the IOC valleys were successful in that a number of processes used in the siting of shelters were tested and the processes did work. An analysis of the program also identified some deficiencies, as might be expected when procedures are tried for the first time. By discussing the deficiencies, it should be possible to improve on the process and develop a siting methodology that can be used for future studies. Some of the areas where improvements can be made are discussed in the following sections.

6.3.1 Planning

It is important that all office activities are completed before starting the field survey program. This includes approval of

the layouts by AFRCE-MX, determining and checking the survey coordinates of the entire study area, and obtaining the necessary permits to perform the field work. Detailed schedules need to be prepared to assist in the coordination of the field program.

The field survey process requires close coordination between the geotechnical staff, cadastral survey teams, and biological and archeological scientists. The cadastral survey teams need sufficient lead time to monument enough sites so the environmental survey teams have an adequate number of sites to study. The right mix of personnel is essential so that survey teams keep just ahead of the environmental inspection teams.

6.3.2 Coordination with State and Federal Agencies

Coordination and information exchange with various state and federal agencies at an early stage in the layout process can optimize land-use concerns and minimize adverse impacts on the environment. Data on valley resources can be studied and taken into account during the layout process. Sufficient lead time is necessary to allow all interested parties an opportunity to cite specific areas of interest or concern and to incorporate any AFRCE-MX approved changes into the layouts.

6.3.3 Coordination with Local Users of the Valleys

This study indicated that contact with the local users of the valleys should be made prior to starting field surveys. Field contact between the local users and the IOC Program Manager

alleviated most potential problems by providing information on the program, its purpose, and how it could affect them. Due to the controversal nature of the MX program, several situations did arise that could have been avoided with advance public relations.

6.3.4 Adequacy of Cultural Data

The layouts for the IOC valleys were completed while existing cultural data and planned and proposed cultural actions were still being compiled. These data included transmission lines, power line corridors, wildlife management plans, land status data, and mining claims. For example, a right-of-way exists in Wah Wah Valley for a proposed powerline to the Pine Grove area. Several shelters were impacted when this additional data was added to the valley data base. If more data had been available, better layouts could have been produced. When new data are obtained after layouts have been completed, it can be more difficult to incorporate the new data because of constraints imposed by the layout criteria.

6.3.5 Identification of Biological Resources Prior to Preparing Layouts

The field surveys verified the importance of evaluating biological resources data, such as vegetation associations, habitats, and migration routes, prior to preparing layouts. This was particularly apparent in Pine Valley, Utah. Biological resources data on the valley, received after the layouts were completed, resulted in improved site locations when the new data were incorporated into the layout.

6.3.6 Identification of Cultural Resources Prior to Preparing Layouts

Cultural resources findings generally occur as discrete sites, rather than large areas. When the data is available, it is incorporated into the environmental data base and avoided. Certain cultural resources sites, especially those related to Native Americans may not be identified in the literature or available through various agencies. In these cases, siting may conflict with existing cultural resources. The siting methodology effectively takes into account evaluation and avoidance of known cultural resources.

6.3.7 Scheduling of Field Work

The field surveys need to be scheduled so the optimum amount of data can be obtained. The field surveys were conducted during the fall and winter when the field teams were hampered by dense fog, cold and winds, and the survey area obscured by snow cover. A complete evaluation of the biological resources was not possible during the field surveys since some plants were either dormant or lacking the flowers that are used for positive identification.

6.4 SUMMARY AND CONCLUSIONS

The field surveys in the IOC valley did demonstrate that the siting criteria are reasonable and can be used, the verification process used to identify suitable area boundaries is successful, a map scale of 1:9600 is adequate, the shelter layout process works reasonably well, and the procedures used to perform field

surveys were successful. The surveys also revealed some deficiencies. The deficiencies in the procedures used were of a minor nature and were of the type that might be expected when performing a task for the first time. A number of improvements were implemented during the course of the program.

The major deficiencies were not in the procedures used but in tasks which should be incorporated into the program to develop a methodology which provides the best possible layout. Taking into account all of the geotechnical, cultural, and environmental factors and priortizing these factors to the satisfaction of all interested parties is a complex problem. Contributions from a variety of disciplines and integration of geotechnical and environmental concepts are required. The field surveys were a good first step in the learning process. If integrated with other tasks which have been identified in this section in combination with comments from state and federal agencies who have evaluated the field survey process, an improved field survey program can be expected in other valleys.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The IOC field surveys program was a pilot program to:

- Locate shelters, CMFs, RSSs, and roads in the field;
- Evaluate environmental and geotechnical conditions at each site;
- Improve site locations, where warranted; and
- Develop legal descriptions of sites.

By necessity, the program evaluated techniques and data (cultural, geotechnical, and engineering) used to delineate suitable and siteable area, the process used for MPS layouts, and all aspects of the field surveys (surveying, environmental, and geotechnical).

The IOC program showed that the Verification Program uses viable techniques that successfully delineate suitable areas and can be used with a high degree of confidence to predict siteable areas for shelters and roads. Two shelters out of the 493 sites surveyed were relocated due to rock or shallow rock in areas that should have been excluded from the suitable area. Most other shelters were relocated for factors that cannot be recognized at the scale of the maps or color aerial photographs.

The process used to derive shelter layouts is fundamentally sound. The methodology developed by the layout process was constantly changing as the needs of the project evolved. After the mechanical process was refined, it was impacted due to the constant changes that are inherent in the project. Layouts began in the IOC valleys while the siting requirements were

still evolving and before geotechnical and regional environmental investigations were completed. The tight time schedule for the IOC valleys was predicated by the planned date for submittal of the land withdrawal application.

The survey effort was impacted because coordinates for all the sites were not available at the start of the program. The layouts for Pine and Wah Wah valleys were changed after the field surveys began because BMO/AFRCE-MX wanted to respond to comments received and changes suggested by various state and local agencies. The sites could not be surveyed in a systematic manner; sites were surveyed as coordinates were received.

The field effort was totally dependent on prevailing weather conditions due to the timing of the program. Damage to existing roads and off-road areas may have been lessened if the surveys were carried out at a different time or if different field logistics were used. Valley-wide reconnaissance of cultural and biological resources could have added to the data on which recommended relocations was based. Geotechnical investigations were adequate on a site-by-site basis.

The existing hex cell layout restrained the degree of freedom necessary for some shelter relocations. Compromises and waivers of criteria were necessary in some cases to respond to site-specific situations.

The following are recommended for future field survey programs:

o Adequate lead time is required to assemble all pertinent data prior to initiation of layouts;

- Layouts need to be approved and finalized prior to field surveys;

- Land surveyors require adequate lead time to uncover existing controls and establish control networks before environmental and geotechnical inspections begin;

- All survey coordinates should be released to the land surveyors at the same time;

- A permanent, standing marker should be located near the true point of beginning of each surveyed site;

- An on-site program manager is necessary to coordinate all phases of the program; and

- Environmental surveys should be planned to optimize data collection.

APPENDIX A1.0

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APPENDIX A2.0

GEOTECHNICAL MITIGATION

A discussion of geotechnical factors applied to site locations and mitigation criteria is presented in Sections 2.3.4 and 2.3.5. This section expands on that discussion and provides specific examples and rationale behind recommended site relocations. The purpose of the geotechnical and engineering studies used as a basis for the suitable and siteable area maps is to identify areas that are unsuitable, according to BMO/AFRCE-MX requirements, for locating shelters and other facilities for the MX system. The ideal locations for these facilities are on the lower portions of the valley in areas that are not subject to sheet flooding. Figure A2-1 is an example of an ideal shelter or CMF site: flat terrain, no incisions across the area, loose, sandy soil that will promote drainage, and easy to excavate. Most of the shelters and CMF sites exhibited conditions similar to those shown in the photo and will offer few construction problems.

Other conditions are present within the valleys that will present small to significant problems to construction and to maintaining, or minimally impacting the existing hydrologic regimes. There are appreciable areas within the valleys, especially near the existing active playas, that are slow draining. These areas are characterized by silty or clayey soils that, due to the extremely small gradient across the site, tend to pond water for periods of time (Figure A2-2). In most cases, modification of the existing terrain by construction will effectively eliminate

GENERALIZED OVERVIEW OF A TYPICAL SITE (WAH WAH HSS 4-15). NOTE FLAT TERRAIN, LACK OF WASHES, AND LOOSE SANDY SOIL. VIEW NE OF SITE FROM THE TPB.

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TYPICAL SHELTER SITE –
IOC VALLEYS

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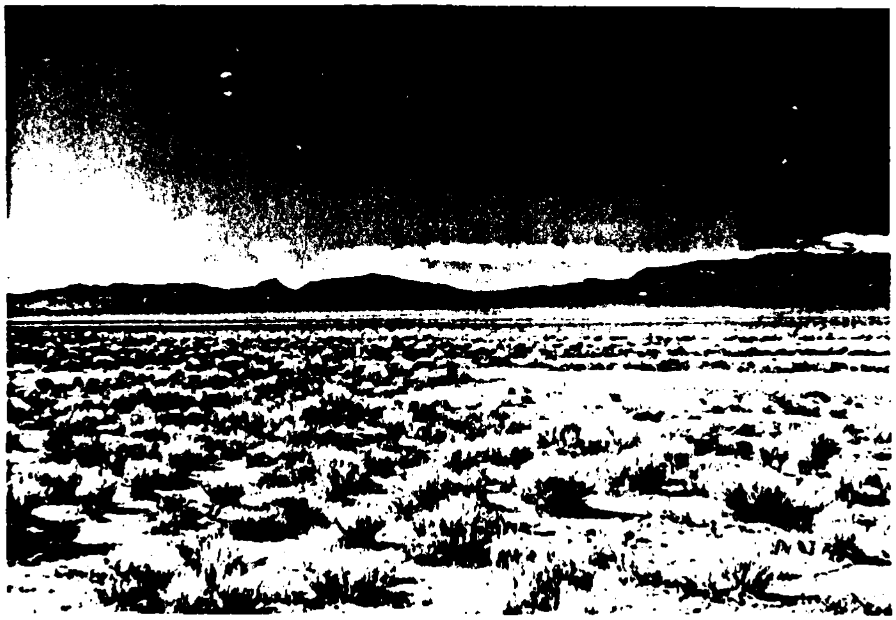
FIGURE A2-1



TYPICAL SITE LOCATED ON THE EDGE OF PLAYA DEPOSITS (DRY LAKE VALLEY HSS 2-16). WHITE OR BUFF AREAS REPRESENT SILTY OR CLAYEY SOILS THAT EXHIBIT SLOW DRAINING PROPERTIES. VIEW SW AWAY FROM SHELTER SITE.

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TYPICAL SHELTER SITE
SHOWING SLOW DRAINING AREAS

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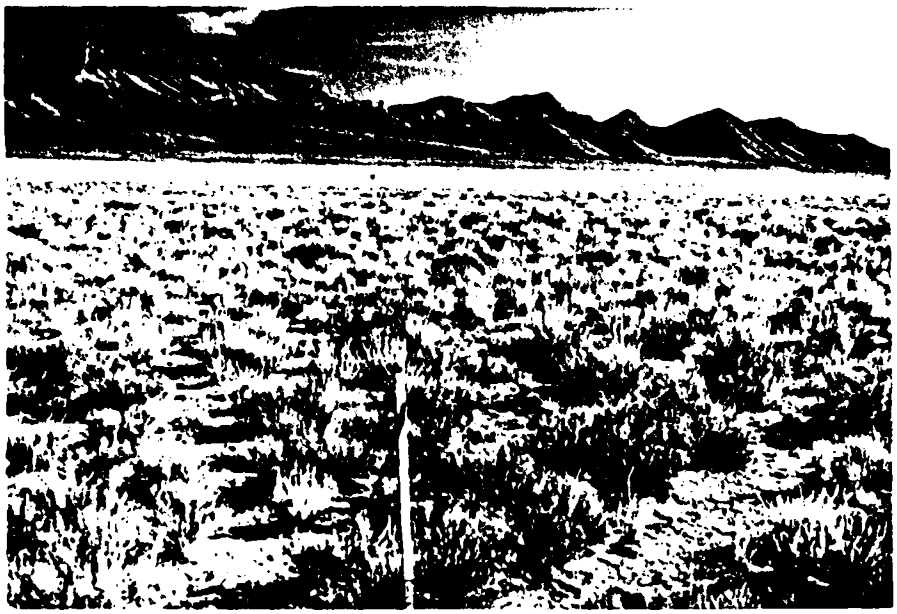
FIGURE A2-2

the problem, but berms may have to be constructed around the site for flood protection.

Another factor that was considered during the geotechnical inspections was potential for sheet flooding. The volume of water, slope of the surface, amount of materials available for transport, and other factors are important considerations. In general, sites that can be affected by sheet flooding are in the bottom of the valleys and near the axial washes. Figure A2-3 is a typical site that could be affected by sheet flooding. Small drainage courses are apparent over most of the surface. Modification of the surface due to construction and the shelter design will effectively eliminate most adverse impacts due to sheet flooding; berms may be required for additional protection from flooding.

Washes cutting through the site posed the major construction consideration and dictated the largest number of shelter and CMF relocations. Processes in alluvial valleys are dynamic; one can always expect portions of the valley to be active. Washes within the valley, especially those on the flanks of the valley, are active, evidenced by vegetation within the channel (indication of the presence of water), active erosion and undercutting of the banks, size and distribution of bedload materials, and size of drainage area. An estimate of the degree of activity, as well as the extent of the drainage area, was required prior to recommending a site for relocation. Figure A2-4 is an example of a wash cutting through a site near the center monument. This



SMALL DRAINAGE COURSES ARE APPARENT ON THE SURFACE OF THE HSS, AS INDICATED BY LACK OF VEGETATION, DEPRESSIONS, AND CRACKS IN THE SURFACE MATERIAL. VIEW TO THE SE FROM THE REAR MONUMENT (DRY LAKE VALLEY HSS 8-13).

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TYPICAL SHELTER SITE SHOWING
POTENTIAL FOR SHEET FLOODING

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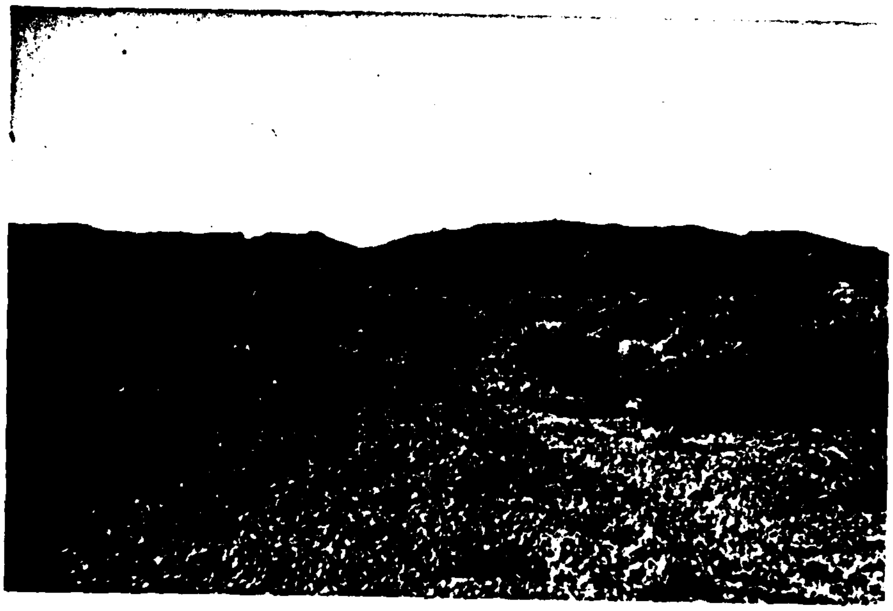
FIGURE A2-3



SMALL WASH CUTTING THROUGH SITE NEAR CENTER MONUMENT (VIEW W). DRAINAGE AREA OF THIS WASH WAS LOCALIZED AND COULD EASILY BE DIVERTED (DRY LAKE VALLEY HSS 1-22).

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WASH WITH SMALL DRAINAGE AREA CUTTING THROUGH SITE	
8 JUL 81	FIGURE A2-4

wash is 1 to 2 feet (0.3 to 0.6 m) deep, 5 to 8 feet (1.5 to 2 m) wide and, at first glance, could be thought to have a major impact on construction of the site. However, its drainage area is small and highly localized. Another larger wash is present near the site, and the wash within the HSS could easily be diverted into this wash.

The steeper flanks of the valleys, near the mountain fronts, presented the most critical areas in terms of geotechnical factors that would suggest relocations. Terrain conditions are generally more rugged and variable at the valley edge, as are a higher incidence of major (5 to 6 feet [1.5 to 2 m] deep, 10 feet [3 m] wide) washes (Figure A2-5). Boulders and cobbles are indicative of the active nature of the fan surface, which if present at depth, could hinder excavation. Alluvial fans are characterized by a distributary drainage pattern, where flow is away from, rather than into, a main channel located near the fan apex at the mountain front. Sites located close to the mountains generally are impacted by this main channel. Diversion could be difficult and could cause a major impact on the existing hydrologic regime. In these cases, relocation of a site, sometimes accompanied by minor diversion of the stream or construction of flood protection devices, can easily mitigate problems.

As noted throughout the report on the IOC methodology, almost all of the sites could have been constructed as they were initially sited. However, due to the low cost, at this stage,

MAJOR WASH CUTTING THROUGH SITE BETWEEN THE CENTER AND REAR MONUMENTS (NOTE REAR MONUMENT AT THE RIGHT OF THE PHOTO) (DRY LAKE VALLEY HSS 5-22).

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MAJOR WASH CUTTING THROUGH SHELTER SITE

8 JUL 81 FIGURE 2-6

APPENDIX A3.0

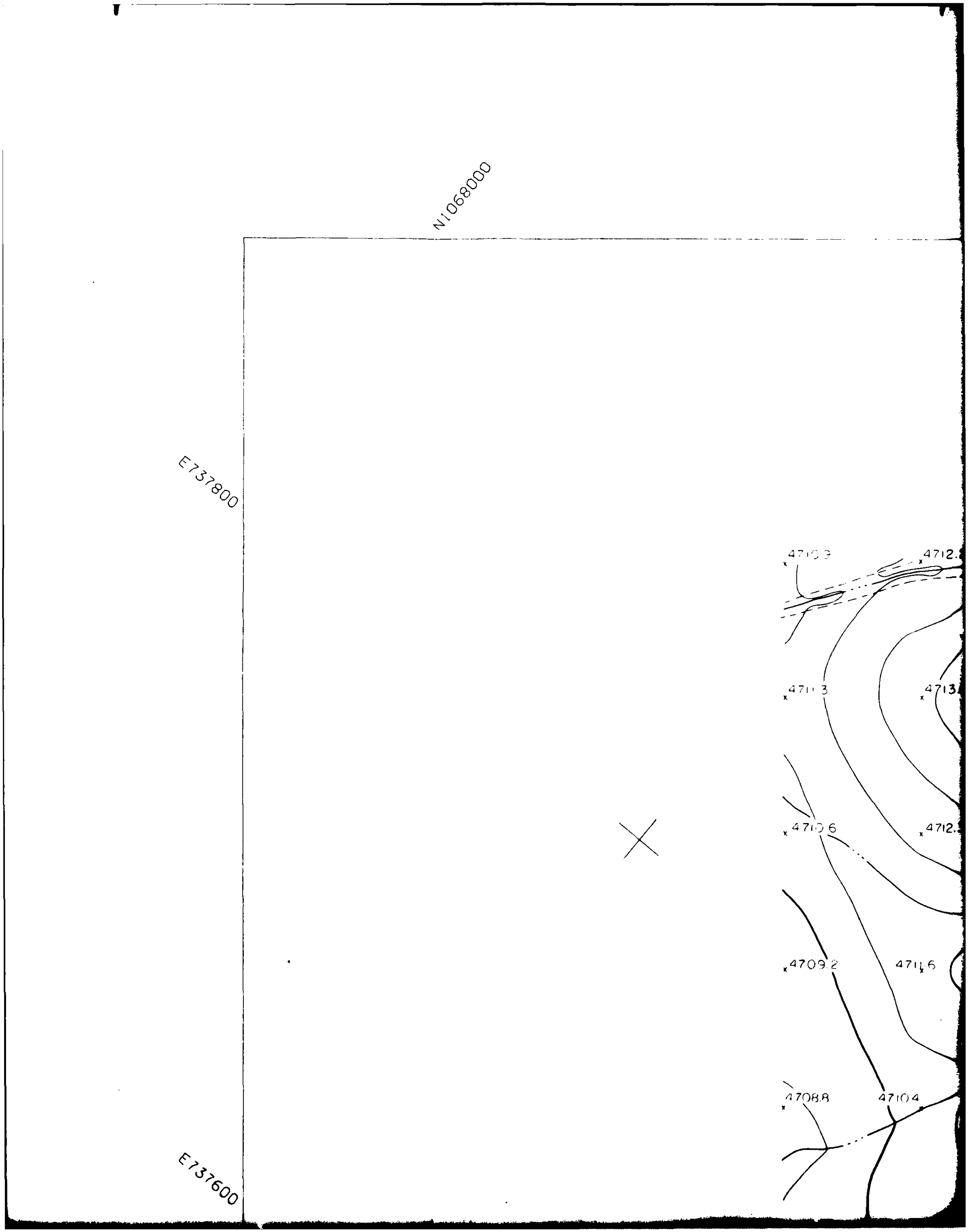
of relocating a site, generally the conservative approach of mitigation by relocation was applied.

DETAILED TOPOGRAPHIC MAPPING

Detailed topographic maps (1 inch = 40 feet [1 cm = 5m]; 1 foot [0.3 m] contour interval) of 23 shelters and the CMF and plan and profile maps of all the roads in Cluster 2, Dry Lake Valley, Nevada, were made as a pilot project. The purpose was to determine detailed terrain conditions at typical shelter sites to aid in future decisions regarding mapping scales and contour intervals needed for design. The terrain in which Cluster 2 was sited was generally flat to slightly dipping and was located near the edge of the playa and along the distal fan margins. Two shelters were relocated in this cluster: one was near a fault and one was within a large (1000-foot [305-m] wide) wash. No other sites were relocated for geotechnical reasons.

The detailed maps provide a greater degree of accuracy and delineates features that are not resolvable on the smaller scale 1:9600 maps. The majority of sites in the IOC valleys were relocated because of washes cutting through or otherwise impacting the site. These washes were generally 5 to 10 feet (1.5 to 3 m) in depth. The contour interval on the 1:9600 scale maps is 10 feet (3 m); therefore a wash that is less than 10 feet (13 m) deep may not be accurately identified on these maps.

Figure A3-1 is an example of the detailed plat map for Shelter 2-11. The shelter location on the 1:9600 scale map is shown in Figure A3-2 for comparison. The 1:9600 scale contour lines suggest several washes cutting through the shelter (MPS) itself.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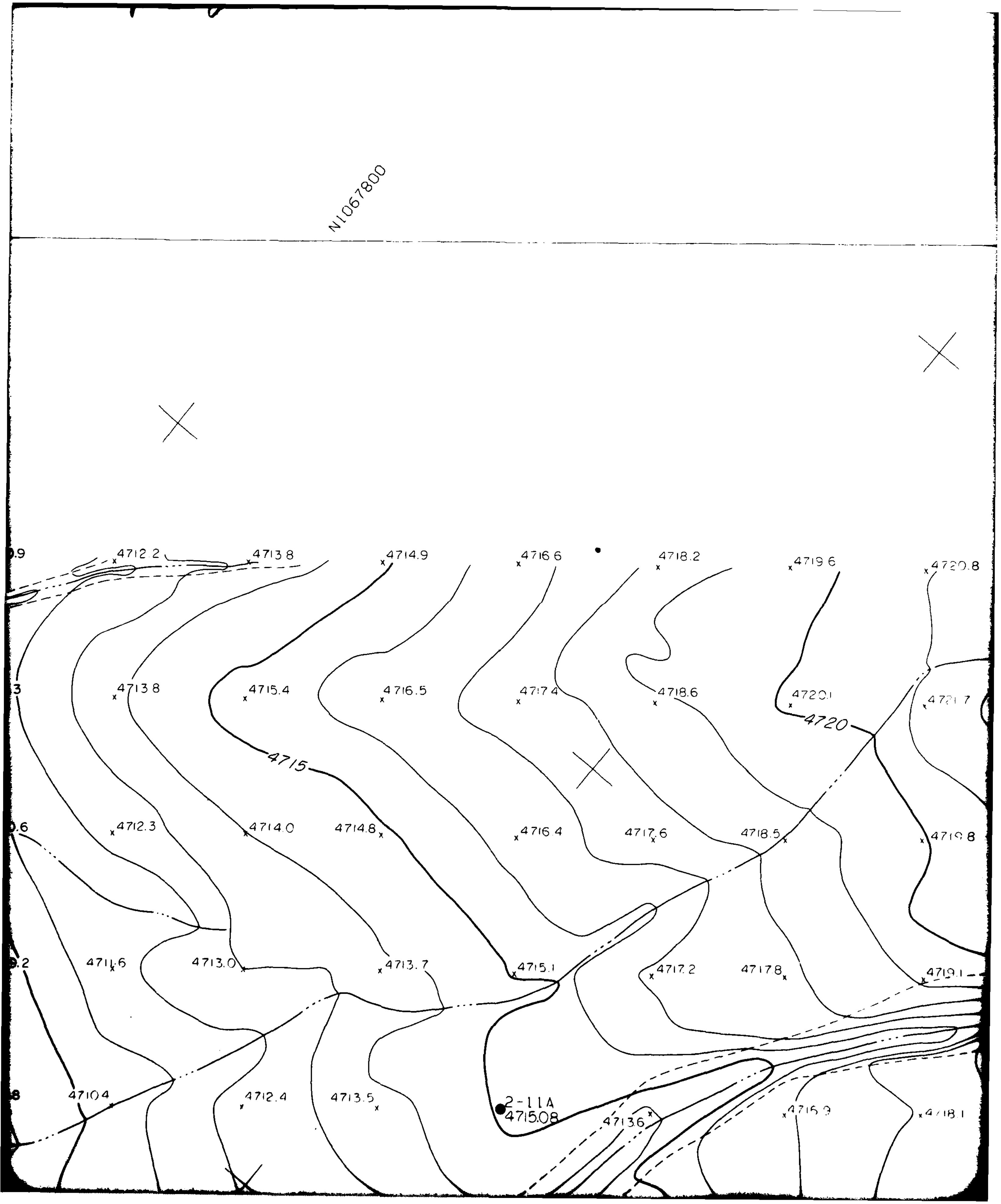

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4717.4
4718.6
4720.1
4720
4721.7
4715
4712.3
4714.0
4714.8
4716.4
4717.6
4718.5
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4711.6
4713.0
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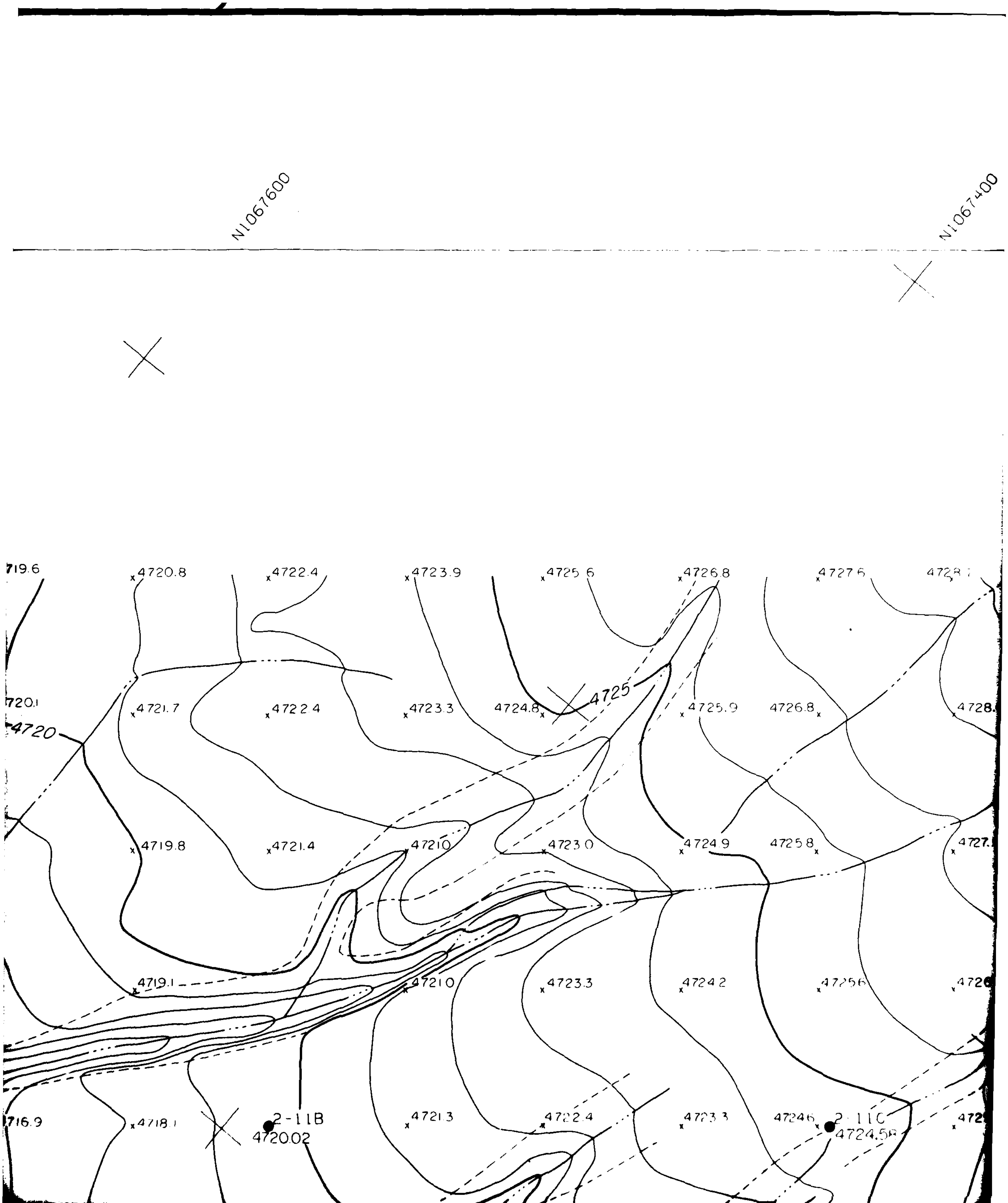

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N1067400
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4722.4
4723.3
4724.8
4725
4725.9
4726.8
4719.8
4721.4
4721.0
4723.0
4724.9
4725.8
4719.1
4721.0
4723.3
4724.2
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4722.4
4723.3
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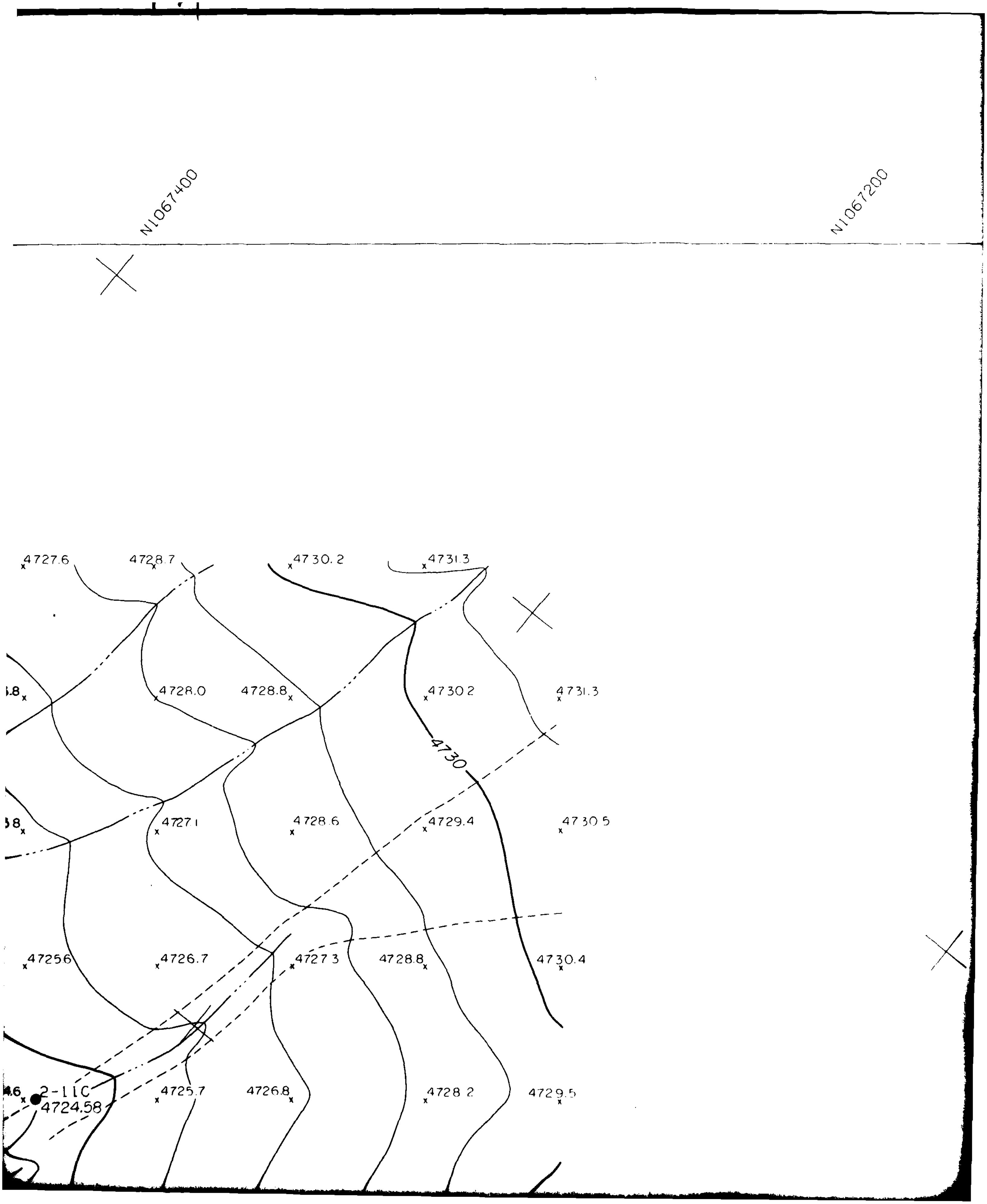
2-11C
4724.58



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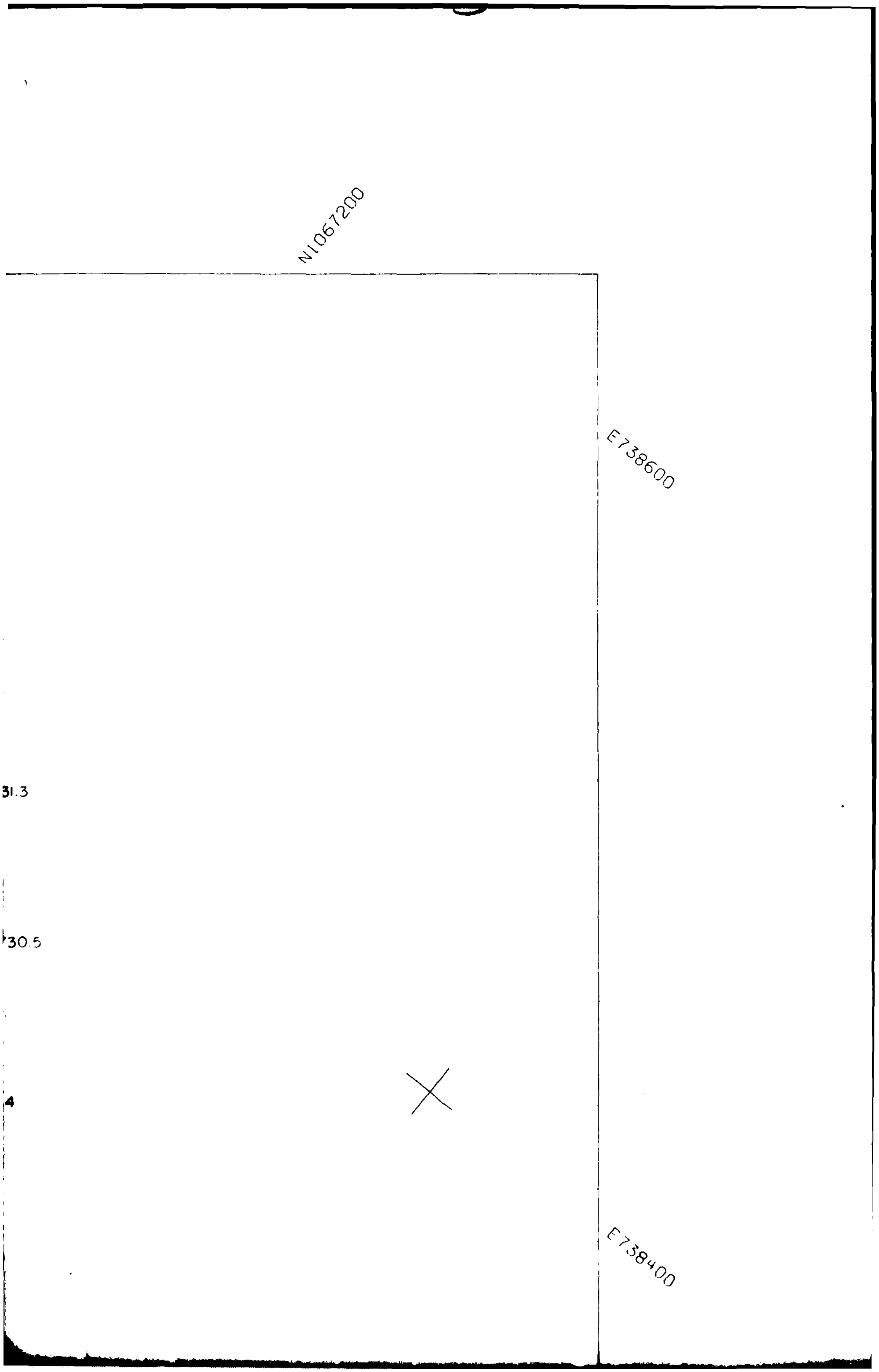
4728.2
4729.5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4
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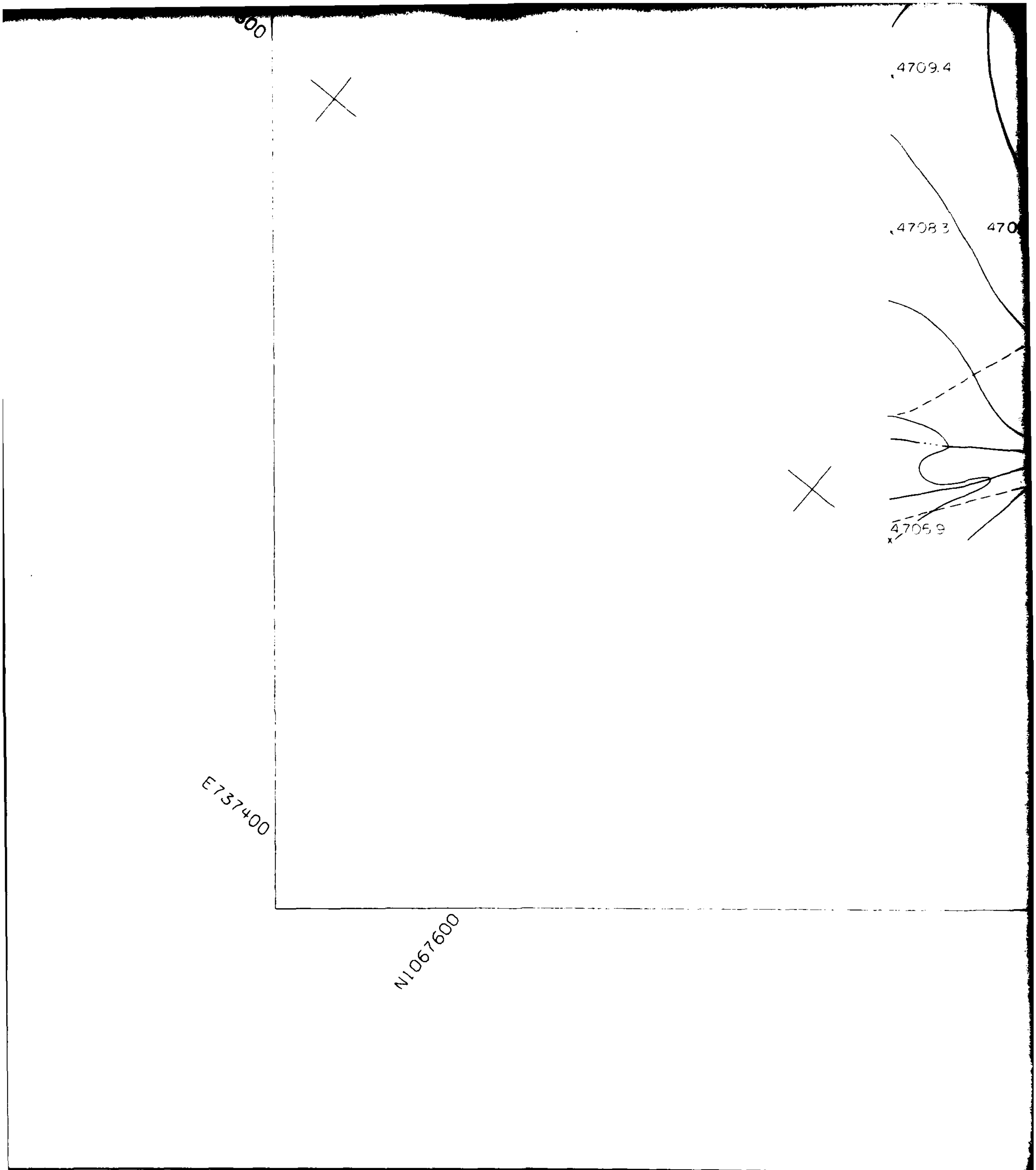
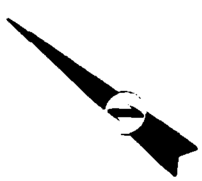
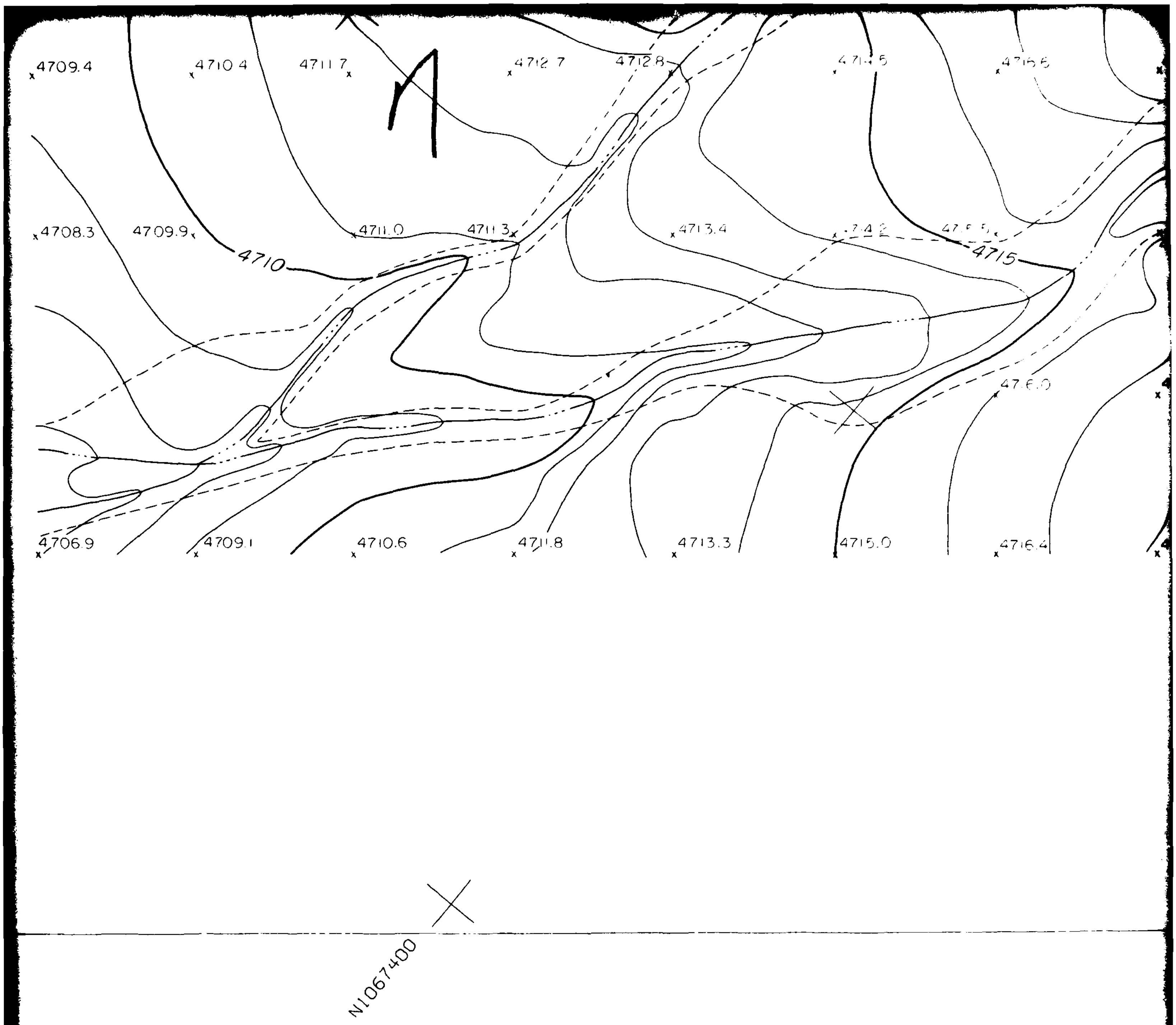




REVISIONS



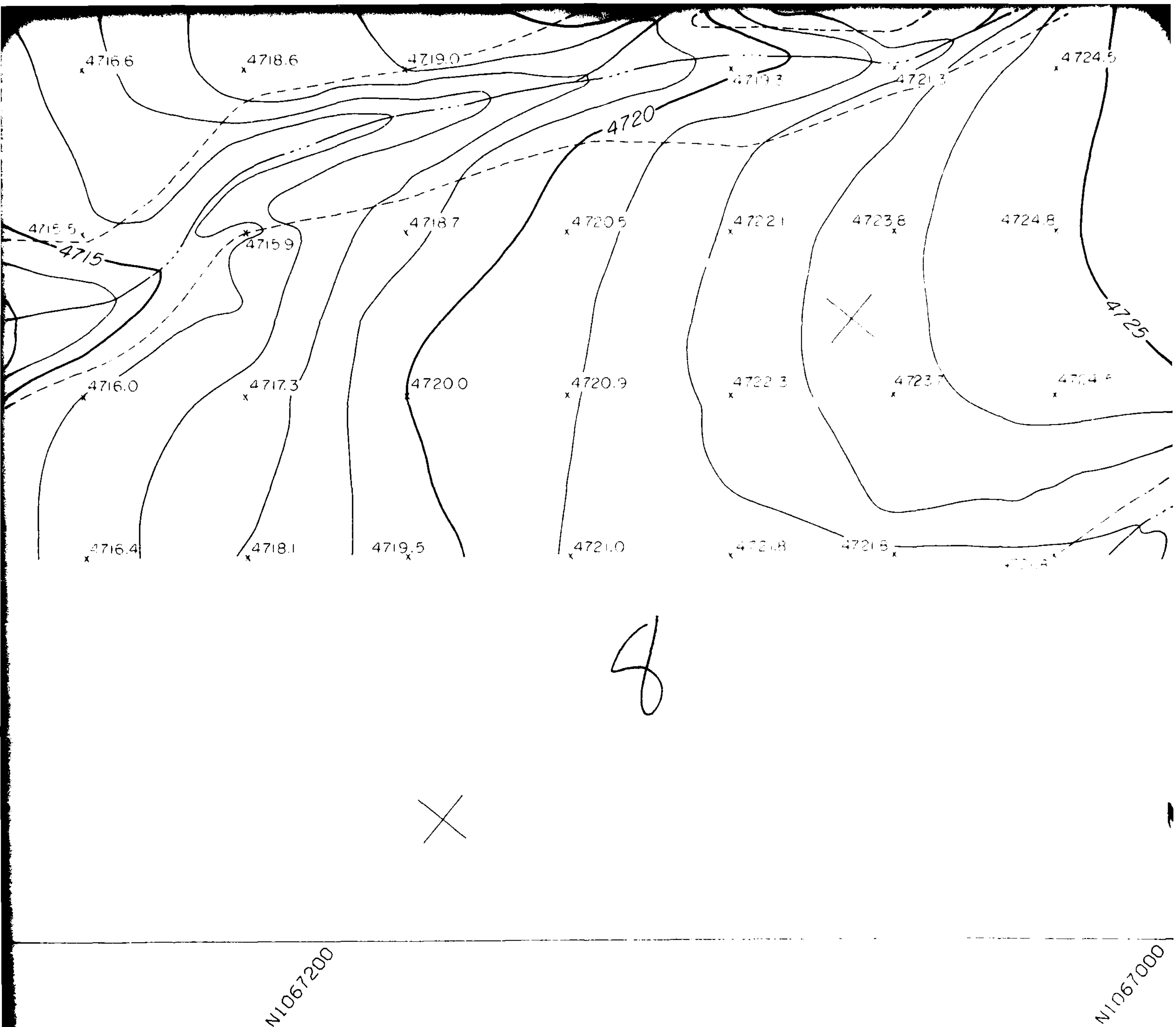
REFERENCES

SHELTER LOCATION BASED ON FIELD SURVEYS PERFORMED IN DECEMBER 1980. ORIGINAL SHELTER LAYOUT WAS A 1:62,500 SCALE DRAWING (DRY LAKE VALLEY LAYOUT VERSION 7, DATED 11 AUGUST, 1980). THE LAYOUT WAS TRANSFERRED TO 1:9600 TOPOGRAPHIC MAPS; SOME CHANGES WERE MADE AND SURVEY COORDINATES WERE DETERMINED. THE "AS SURVEYED" LAYOUT IS SHOWN IN VERSION 9 AT A SCALE OF 1:62,500.

40

SCALE

NEVADA ST



The Earth Technology Corporation

Ertec Airborne Systems, Inc.

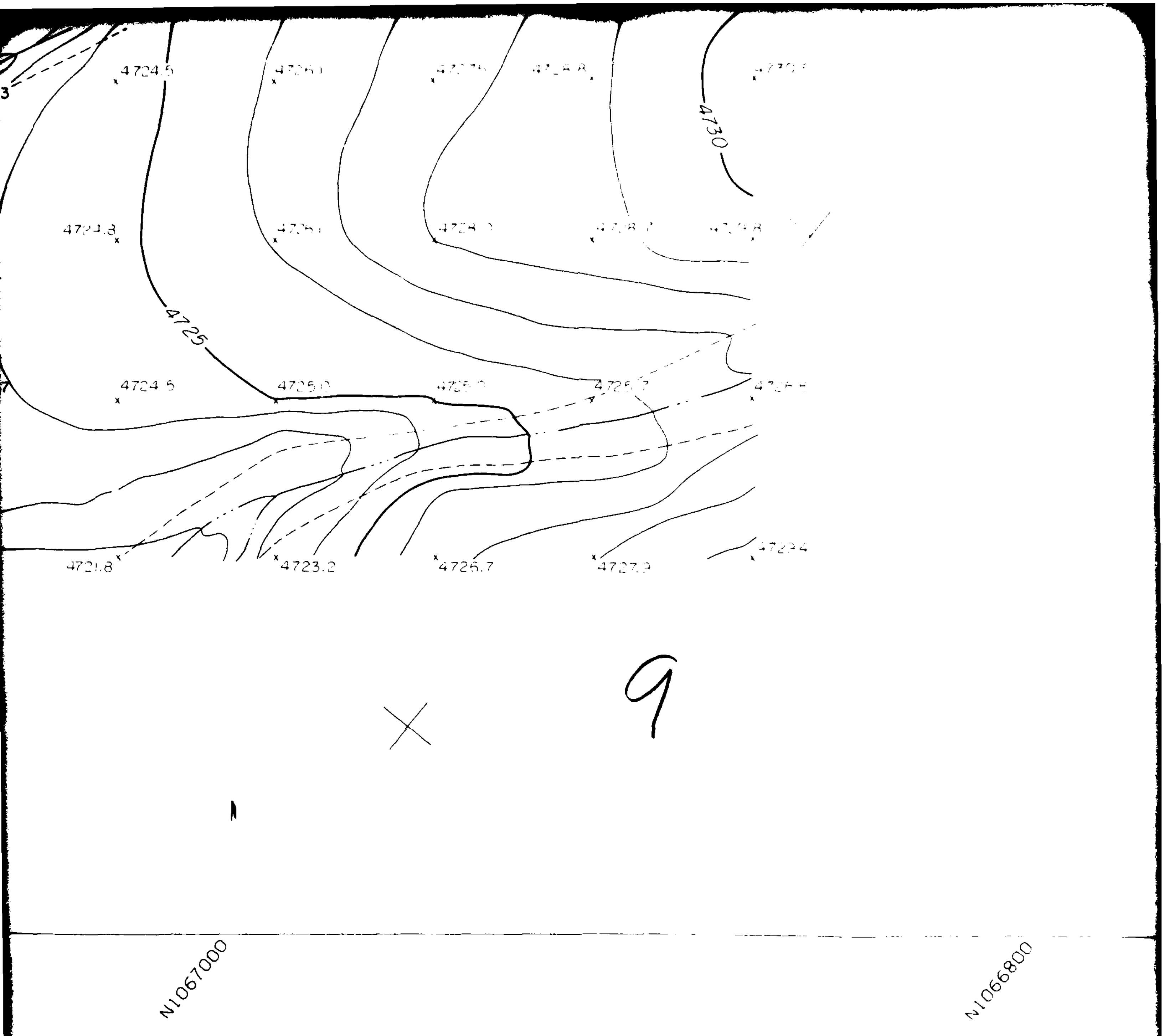
40 0 40 80 120 FEET

SCALE 1" = 40' CONTOUR INTERVAL 1'

NEVADA STATE COORDINATE SYSTEM, EAST ZONE

Prepared Under the Supervision of	Date
Checked By	
Approved By	

MX GEOTECHNICAL SITING STUDIES



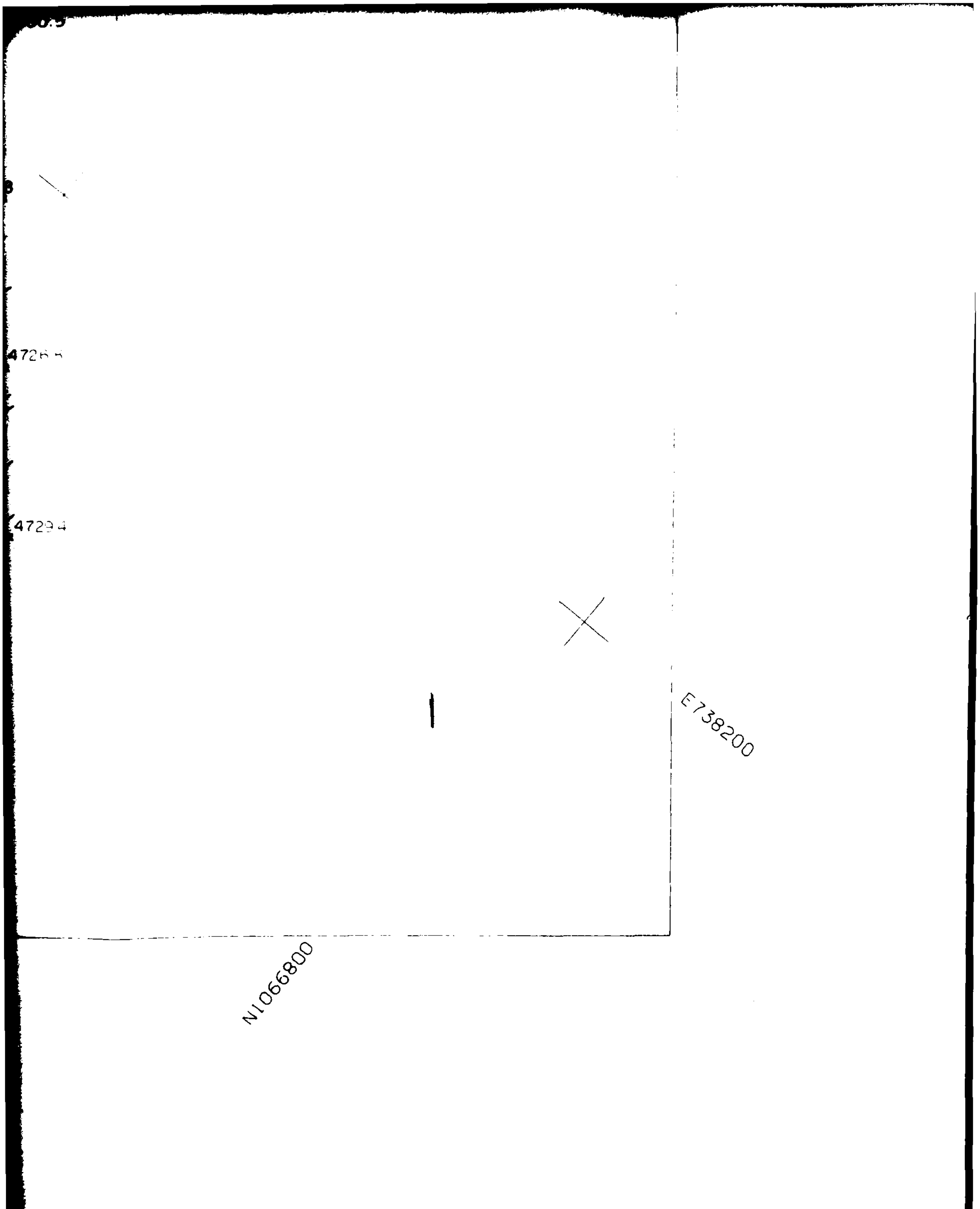
Supervision of	Date

GEOTECHNICAL SITING STUDIES

SHELTER Nº 11 CLUSTER N

DRY LAKE VALLEY, NEVADA

BASIS OF ELEVATION: NATIONAL GEODETIC VERTICAL DATUM OF



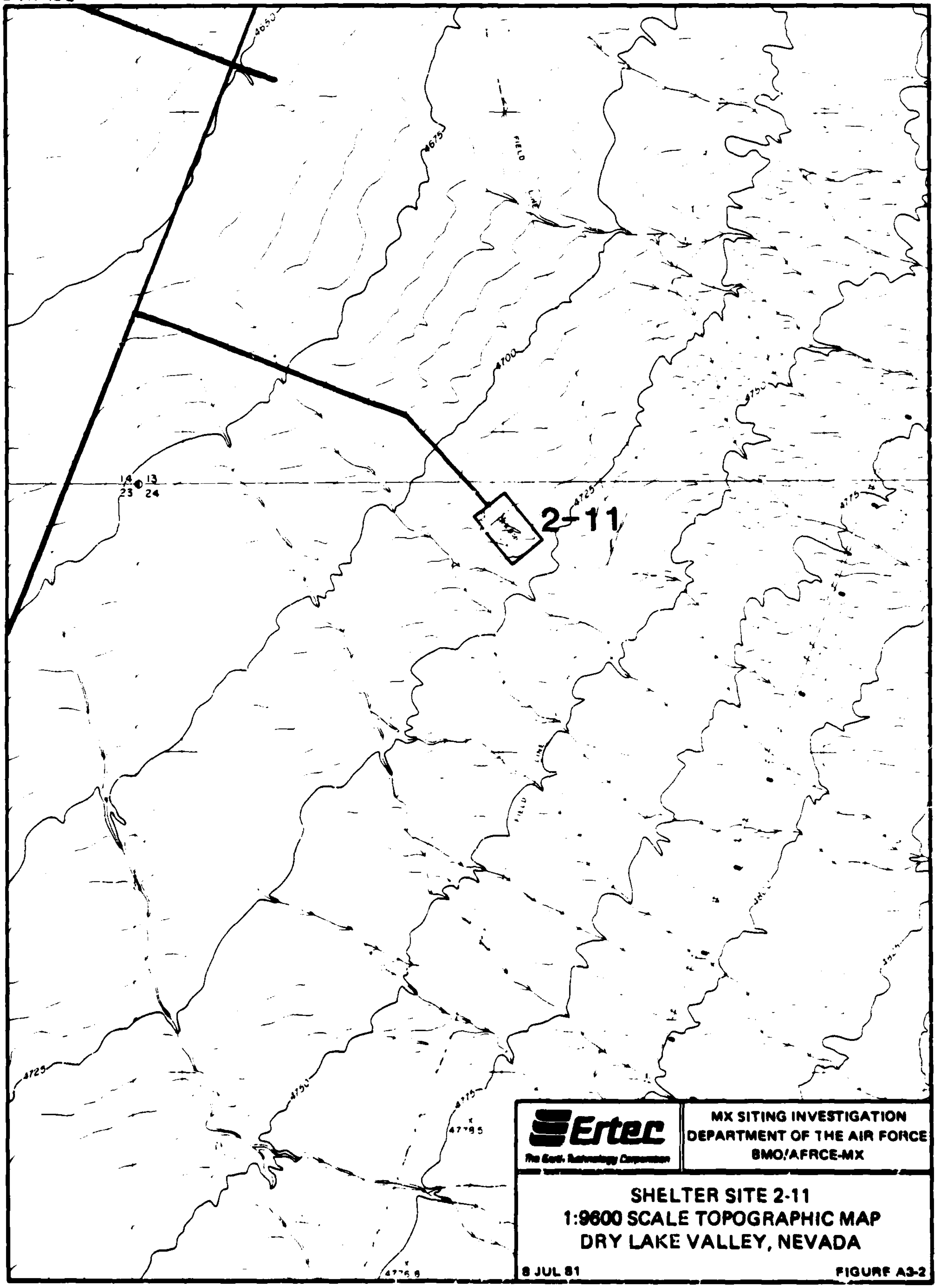
II CLUSTER Nº 2

VALLEY, NEVADA

ONAL GEODETIC VERTICAL DATUM OF 1929

THIS SHELTER IS LOCATED ON 19600 MAP SHEET Nº 32

SHELTER 11 OF 23



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SHELTER SITE 2-11
1:9600 SCALE TOPOGRAPHIC MAP
DRY LAKE VALLEY, NEVADA

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FIGURE A3-2

The site appears to have an irregular surface. The spacing of the contours suggests the larger wash is almost 7 feet (2 m) deep, that its drainage area is large, and it is connected to the entire drainage system coming off the fans of the east side of the valley. The detailed map, however, shows the wash is generally only 2 to 3 feet (0.6 to 1 m) deep, and its depth decreases up stream. The flatness of the slope of the site toward the east indicates the drainage area is limited, and probably does not drain much area beyond the site itself.

DATE

ILME